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GOING THROUGH ELLIS ISLAND

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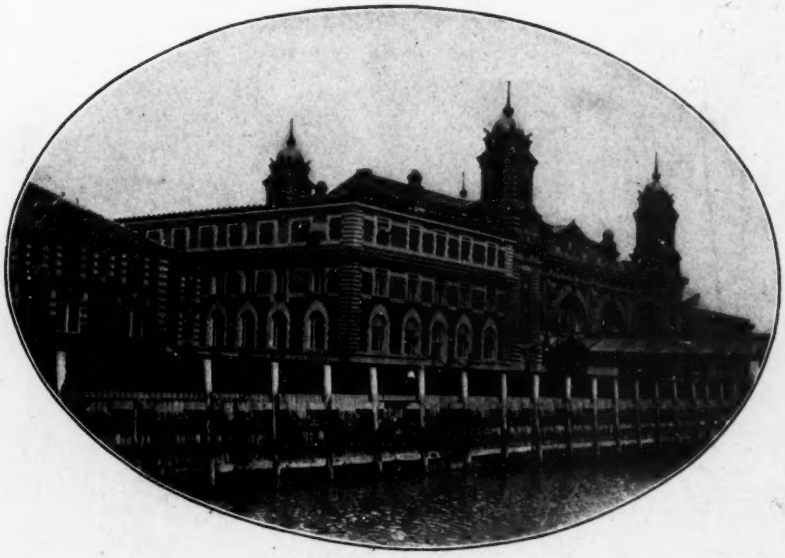
IT is at least a question whether the visitor to Ellis Island looks at the newly landed immigrant with eyes any more curious than those with which the immigrant looks at the visitor. The one sees the timidity, the surprise, the fear and the expectation of the new-comer. The other sees what is to him a wonderful model of all that is American.



MAIN IMMIGRATION BUILDING.

It is a busy island. Yet in all the rushing hurry and seeming confusion of a full day, in all the babel of language, the excitement and fright and wonder of the thousands of newly-landed, and in all the manifold and endless details that make up the immigration plant, there

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is system, silent, watchful, swift, efficient. Five thousand immigrants in a day is no uncommon figure. Five thousand six hundred passed through last Easter Sunday. Five hundred and twenty-five persons are employed on the island exclusive of the score of medical officers and the hundred or more attendants of the Public Health Service.

It is an island crowded full of pathos and tragedy, of startling contrasts and unexpected humor. A burly, laughing giant of a man came

THE IMMIGRANT HOSPITAL AT ELLIS ISLAND.

down the line one afternoon, elated to have reached the land of his life-long hope. The next morning he lay stricken with meningitis and that evening was dead. A young mother was separated from her two-year-old baby because the baby had diphtheria. In a few days the baby died, and the mother went on alone to the father waiting in the west. The reunion of broken families, and the old folks coming to live in the home prepared by the pioneer children, constantly afford views of human nature unmasked and unrestrained.

All races and conditions of men come together here and adjust themselves more or less amicably to each other. Children with no common bond of race, language or religion, play together perhaps more happily for that very reason. Some have been here for months. In the New York room, a Flemish couple have waited seven long months for a little girl who is still sick in the hospital. Every morning on his rounds they ask the doctor how soon she can come to them, and thrice a week they visit her bedside. Perhaps by now their long waiting is

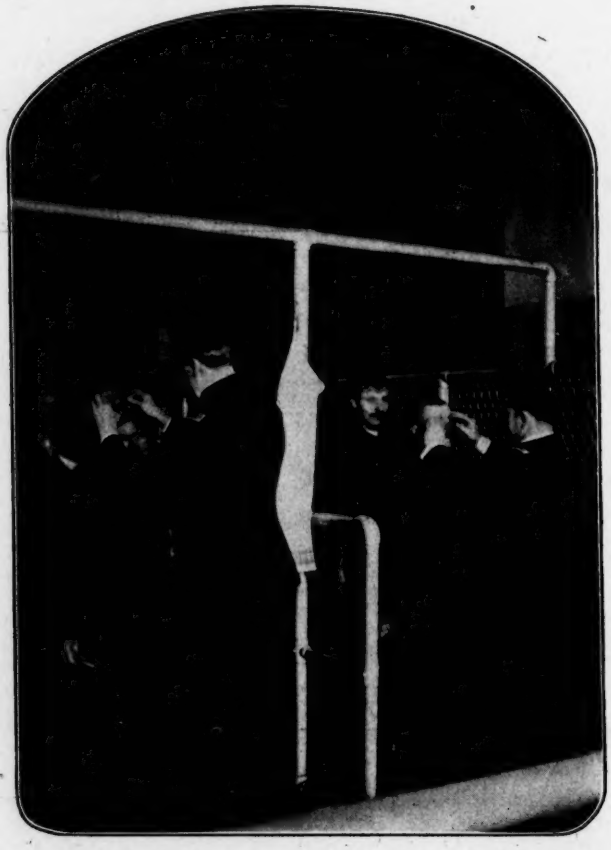
finished, and she has gone on with them happily to the new home in America.

America is the land of the alien, and even now his mark is plain on all our institutions. But while the principal increase in population has been by immigration, the character of that immigration has changed markedly in the past thirty years. Previous to 1883, western and northern Europe sent a stalwart stock, 95 per cent. of all who came. They sought new homes and were settlers. Scandinavians, Danes, Dutch, Germans, French, Swiss and the English islanders, they were the best of Europe's blood. They were industrious, patriotic and far-sighted. They were productive and constructive workers. Where nothing had been, they planted, and mined, and built, and toiled with their hands, while yet finding time to educate their children and train them to love the new mother-country and appreciate the blessings she furnished.

But for three decades the immigrant tide has flowed more and more from eastern and southern Europe. The others still come, but they are far outnumbered by the Jews, Slavs, the Balkan and Austrian

A Polish Mother holding her Baby up to see the Doctor.

races, and those from the Mediterranean countries. In contrast with the earlier immigration, these peoples are less inclined to transplant their homes and affections. They come to make what they can in a few years of arduous unremitting labor, and then return to their homes to spend it in comparative comfort and ease. It has been well



EXAMINING EYES ON THE LINE AT ELLIS ISLAND.

said that America is their workshop, Europe their home. Thirty per cent. of them return to their former homes.

As a class, they contribute little of lasting value but the work of their hands for which they are well paid. And from what they earn they send home no small part. In 1907 they sent $275,000,000 out of the country. True, this money was earned, but its greater value in investment and development was lost. In contrast to their predecessors, the immigrants since 1883 tend to form a floating population. They do not amalgamate. They are here in no small degree for what they can get. It is not always true that they come to supply a real demand. The periodical advertisement of a national demand for cheap labor does not spring from a true economic need, even though the influx of cheap labor might put more money in the employer's pocket.

Such is the type of the newer immigration, and its changing and deteriorating character makes restriction justifiable and necessary. No one can stand at Ellis Island and see the physical and mental wrecks

who are stopped there, or realize that if the bars were lowered ever so little the infirm and mentally unsound would come literally in hordes, without becoming a firm believer in restriction and admission of only the best. The average citizen does not realize the enormous numbers of mentally disordered and morally delinquent persons in the United States nor to how great an extent these classes are recruited from aliens, and their children. Restriction is vitally necessary if our truly American ideals and institutions are to persist, and if our inherited stock of good American manhood is not to be depreciated.

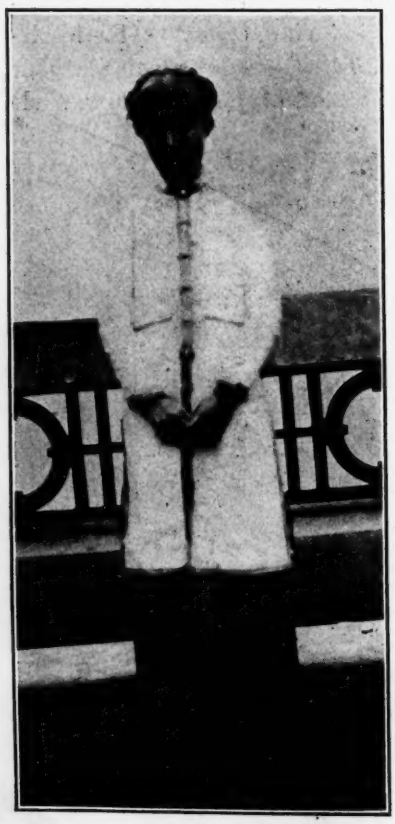
This restriction can be made operative at various points, but the key to the whole situation is the medical requirement. No alien is desirable as an immigrant if he be mentally or physically unsound, while, on the other hand, mental and physical health in the wide sense carries with it moral, social and economic fitness. The present United States immigration law (legislation of 1907) is very definite in its statement of medical requirements for admission. The law divides physically and mentally defective aliens into three classes. Class A includes those whose exclusion is mandatory under the law because of a specified defect or disease. In this class are idiots, imbeciles, epileptics, the feeble-minded, insane and those subject to tuberculosis, or a dangerous or loathsome contagious disease. When a medical diagnosis has been made

RUSSIAN GIRLS.

of these conditions, that person is automatically excluded. In Class B are conditions which are not mentioned in Class A, but which make the person affected liable to become a public charge or affect his ability to earn a living. Class C includes defective and diseased conditions not included under A or B but which must nevertheless be certified for the information of the immigration officials.

The medical inspection of all immigrant aliens is performed by officers of the United States Public Health Service. This service dates from an act of congress in 1798 creating the original Marine Hospital Service, which conducted hospitals at all large ports and inland waterway cities for seamen of the American merchant marine. The duties of the service have since been enlarged to include all features of national health protection. Its officers rank equal with those of the army and navy medical corps, and are found in all parts of the world pursuing their investigations and carrying out measures to protect the public health of the United States. The medical inspection of immigrants is not the least important of their functions. The Bureau of Immigration is under the

A Russian Jewish Boy, just landed.



A Chinese Girl in the Dentition Quarters.

Department of Commerce and Labor, while the Public Health Service is under the direction of the Secretary of the Treasury.

There are 82 immigration stations embracing the entire coastline and frontiers of the United States as well as the entry of aliens into the Philippines, Porto Rico and Hawaii. During the fiscal year of 1911, the total number of immigrants examined was 1,093,809. Of these 27,412 were certified for some mental or physical defect. By far the most important point of entry is Ellis Island, where 749,642 aliens were examined. Nearly 17,000 medical certificates were issued here, and more than 5,000 of these were deported.

The Ellis Island station of the Public Health Service has 25 medical officers attached, including 6 specially trained in the diagnosis and observation of mental disorders. Their work is divided into three sections, the boarding division, the hospital and the line. The boarding division has its offices at Battery Park, N. Y. By means of a fast and powerful cutter, *The Immigrant,* these men meet all incoming liners as they leave the New York Quarantine Station and start up the bay. Their inspection is limited to aliens in the first and second cabins. Such as require a more careful and detailed examination are sent to Ellis Island. The others are discharged at the dock, after having passed the additional inspection of the Department of Commerce and Labor. At the dock, all third and fourth class aliens are transferred to barges, carrying about 700 each, and taken to Ellis Island.

Ellis Island lies close to the Statue of Liberty on Bedloe's Island, about a mile from Battery Park. It is the most commanding location in New York Harbor. It consists of one small natural island and two additional artificial ones, connected with the first by a covered passageway across the intervening strip of water. On the first island is the main immigration station. The other two are occupied by the hospital division of the medical service. On one of these is the general hospital and on the further one the contagious hospital, consisting of separate pavilions, connected with open covered passageways. Each hospital can accommodate close to 200 patients at once, and is usually fairly full. The service is limited strictly to aliens, and the expense of each immigrant receiving hospital care is charged to the steamship company which brought him. This hospital is excellently conducted and every method of most approved diagnostic, surgical and medical technique is practised. A rare variety of diseases is seen. Patients literally from the farthest corners of the earth come together here. Rare tropical diseases, unusual internal disorders, strange skin lesions, as well as the more frequent cases of a busy general city hospital present themselves. The variety of contagious diseases is unusual and extreme diagnostic skill is required of the physicians in charge. In the fiscal year 1911, over 6,000 cases were treated in the hospital, exclusive

THE MATRON AND SOME OF HER CHARGES ON THE ROOF.

of 720 cases transferred to the Quarantine Hospital at the Harbor entrance before the completion of the present contagious hospital on Ellis Island.

The third division of the medical inspection is "the line" or primary inspection. This is the part that the visitor to the island sees, and has been often described. Suffice it to say that as the immigrants leave the barges they pass in single file before the medical officers who pick out all who present evidence of any mental or physical defect. They are turned aside into the medical examining rooms for more careful observation. Each defect or disease receives a medical certificate signed by three physicians, which places the bearer in one of the three classes already mentioned. Those who require immediate medical or surgical care for any reason are transferred to the hospital, as are also certain cases in which longer observation and more detailed examination are necessary for diagnosis. Examples of this are tuberculosis, parasitic scalp diseases, mental disorders and trachoma.

Having been certified or passed clear in the medical division, the immigrant goes together with those from the barge who have not been turned aside, to the upper or registry floor, for the inspection of the immigration authorities. These inspectors ask the same questions that the immigrant was required to answer when the ship's manifest was filled out before embarkation. This covers such information as name, age, destination, race, nativity, last residence, occupation, condition of health, nearest relative or friend in the old country, who paid his pas-

sage, whether in United States before, whether ever in prison, whether a polygamist or anarchist, whether coming under any contract labor scheme, and personal marks of identification such as height, and color of eyes and hair. Any discrepancies in the answers are noted. The immigrant is also required to show what money he has. All who do not meet these questions satisfactorily or who hold medical certificates of classes A or B, are held for a rigid examination before a Board of Special Inquiry, which decides whether or not they shall be admitted. Each of these boards consists of three members, the decision of two members being final. The hearings of the boards are private, but a complete copy of the proceedings is made and filed in Washington.

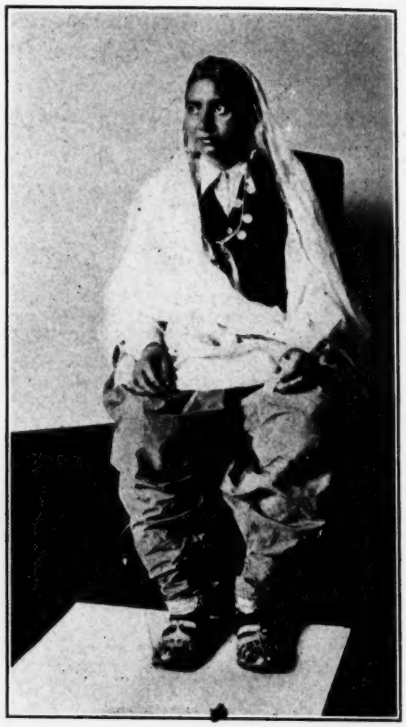
Those who are to be deported are held on the island until the vessel on which they came is ready for its return voyage. In the event of deportation being ordered, the alien may appeal from the decision of the board to the commissioner of the port, from him to the commissioner-general of immigration, and then to the Secretary of Commerce and Labor.

Those immigrants who have passed satisfactorily and are bound for New York City are sent to the "New York room" to await friends or responsible parties who come for them. This is one of the most dramatic and thrilling spots on the island, for it is the reunion place of friends, relatives and lovers. The Irish girl who came two years ago meets the sister and the old mother. The one is pale, nervous, and clad in New York garb; the others have never seen the ocean until their

THEIR FIRST PHOTOGRAPH.

good ship sailed, and their brilliant cheeks and country dress are in keeping with their dense ignorance and shyness. They know the price of shoes and what spuds are worth at market, but it is beyond them to recall the date of their birthday, or what the present month may be.

Those immigrants who are destined for points other than New York City are sent to the railroad room. Here they change their money for United States coin, and buy their railroad tickets under careful supervision. Their baggage is checked, they have a telegraph, cable and post office of their own, and may buy lunches whose contents are exhibited to all in glass cases. Special agents see that each one buys a lunch proportioned to the size of his family and the length of his journey. Cigars, cakes and fruits are also to be had. One day a stolid and emotionless Slavish woman opened her cardboard lunch box at the bottom and extraced a piece of bologna cut on the bias, smelled it carefully from different sides, licked it, finally tasted it, and then broke into a flood of smiles as she pressed it forcibly into the mouth of her equally stolid two-year-old baby. And the baby sucked and munched on the new



A GENUINE HAREM SKIRT.

Photograph, taken at Ellis Island, of a woman from Hindustan.

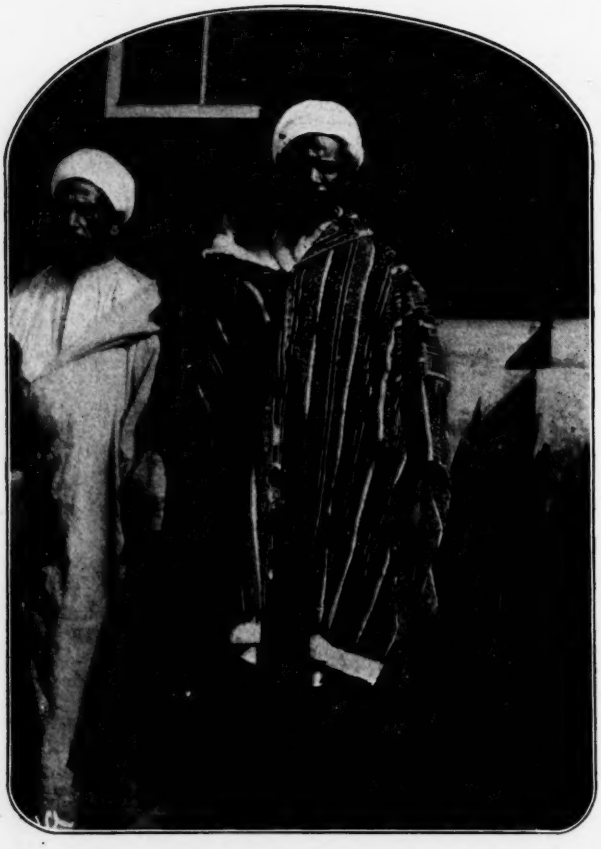
A SERVIAN WOMAN.

world dainty in undiscerning pleasure! But the greatest mystery in the lunch box is usually the small round fruit pie. Some carefully raise the crust and extract the contents with a much-used finger. Another whittles it off in slices with a murderous knife a foot in length, while another will carefully eat off all the crust and discard the interior. A bearded Cossack with great care and patience chewed a hole through one corner of a tin of sardines. Then with praiseworthy perseverance, he sucked out the oil! From the railroad room, the immigrants are taken in barges to the depot of the railroad on which their journey is to be made.

Those immigrants who are to be deported, or who for any reason must be kept on the island some time, are placed in the detention quarters. These are not open to visitors. Tiers of beds are provided, accommodating 1,800 persons, but often this number is exceeded by 500. These quarters are among the most interesting points on the island. The women and children of all races and tongues are in one large room, and the men in another. In mild weather they are all sent on to the fine broad roof of the building. Not long ago a Danish woman who could speak no English and whose baby was in the hospital with diphtheria, became a second mother to a coal-black pickaninny, who had come up from Trinidad on a coffee-ship and whose mother was also in the hospital. Again race wars occur among the children, and Turks and Armenians will battle ferociously with Italians. Mention should be made of the large immigrant dining-room which seats 1,100, where the missionary societies hold a polyglot Christmas entertainment each year.

But the observer at Ellis Island sees only the immigrant stream flowing in. He does not see what results when it has been distributed over the country. No graver questions are before the American nation to-day than those associated with immigration, and none whose correct solution demands more imperative attention. One of these vital questions which is in special prominence just now, is the relation of immigration to mental disorders. This question concerns New York state more acutely than other states only because New York has the largest number of alien defectives.

In February, 1912, there were 33,311 committed insane cases in New York state institutions. It is estimated that more than 8,000 of these or, roughly, 25 per cent., are aliens, and this is exclusive of those conditions of mental defectiveness listed under idiocy, imbecility and feeblemindedness. In the New York schools there are about 7,000 distinctly feeble-minded children, or about 1 per cent. of the school population. Again this does not include idiots and imbeciles to an equal number, not attending school, nor border-line cases and morally defective children. The total number of feeble-minded children in New



A PAIR OF AFRICAN ARABS, AWAITING THE MEDICAL EXAMINATION.

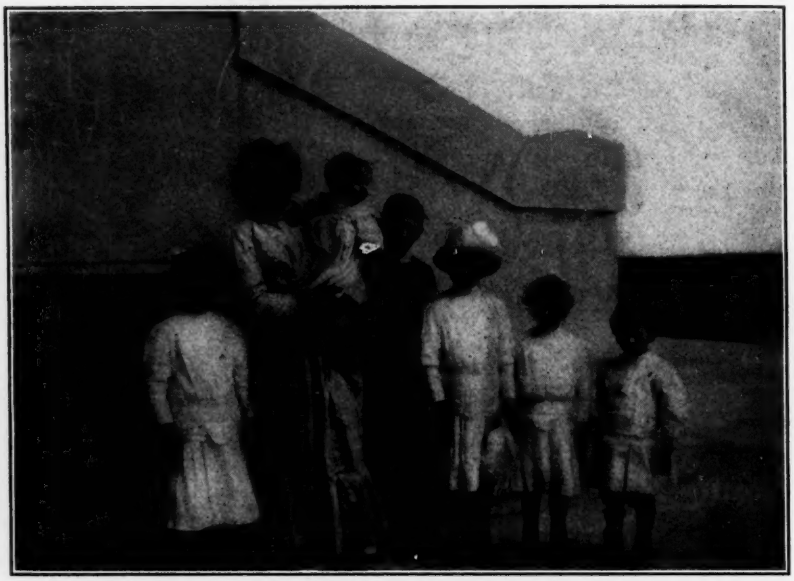
York is about 10,000. According to the figures of the last census, 30 per cent. of the feeble-minded children in the general population throughout the country are the progeny of aliens or naturalized citizens. Thus the presence of 3,000 of New York's feeble-minded children can safely be laid to immigration. These figures show the extreme necessity of careful medical inspection of immigrants. But there are many complicating factors. It is very difficult to recognize many types of insanity. It is almost impossible to detect feeble-mindedness in infants and young children. Yet in spite of this, the medical officers at Ellis Island are doing thorough and effective work, and do not at all deserve the ignorant criticism of those unfamiliar with the difficulties of that work.

A point where criticism is unfortunately valid is in the matter of the deportation of aliens who within three years after landing show themselves subject to any of those conditions which the law excludes, or who become public charges from any cause, said condition or cause

having existed prior to landing. If the present entrance inspection was reinforced by a determined administration of these deportation laws, and if all cases whose exclusion the law makes mandatory, and which are now certified by the medical officers, were actually excluded, there would be little cause for complaint. But such a condition does not obtain. The medical officers have nothing whatever to do in passing judgment on whether an immigrant shall be admitted or not. Their province alone is to certify to his physical and mental status. The question of admission, as well as of deportation, rests with the officials of the Department of Commerce and Labor.

Much easier is the control of organic physical diseases, as, for example, hookworm infection. A survey of the prevalence of hookworm disease throughout the world, made by the Rockefeller Sanitary Commission, shows that this infection belts the world in a zone 66° wide with the equator near its middle, and that practically every country in this zone is heavily infected. It is evident how grave a danger lurks in immigration from any country where the hookworm is prevalent. Among the worst afflicted countries is India, where it is estimated that from 60 to 80 per cent. of the population of 300,000,000 harbor this parasite. This leads peculiar interest to the movement of Hindu coolies into the United States in the last few years. A shipload of these coolies landing recently in San Francisco were found by the health authorities of that port to have 90 per cent. infected with hookworm.

BERBERS FROM ALGERIA, COMING TO FILL AN ENGAGEMENT AT A NEW YORK THEATER.



AN ITALIAN FAMILY.

Every colony and camp of Hindus in California to-day is a dangerous source of infection to all the country around. A rigid quarantine has been established against further importation of this class of aliens.

There are numerous other questions besides those which have been touched on here. Immigration presents one of the most serious problems facing this country. Ellis Island is where the needs and dangers of the country in this regard are focused. Its ever-changing stream of humanity furnishes a fascinating realm for the student of human nature, as well as for study of the great question of economics and eugenics which are involved.

SOME IMPRESSIONS OF THE FLORA OF GUIANA AND TRINIDAD

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TO most botanists in America a visit to the tropics is supposed to be a difficult and expensive undertaking, involving much special preparation and also a good many risks. The fact is, a trip to the West Indies is a very simple matter, and even a few weeks are sufficient to give one an excellent idea of the main features of a most interesting and characteristic tropical flora, and is no more expensive than a journey of equal duration in Europe. If one extends the trip to include the Isthmus of Panama and Trinidad, one sees to great advantage the rich and beautiful flora characteristic of equatorial South America, one of the most individual floral regions of the world.

There are various ways of reaching the West Indies and northern South America, especially since the great development of the fruit industry, which employs many vessels plying constantly between the different ports of the Atlantic and Gulf States, and various ports of the West Indies and Central America. In addition, the Royal Mail (English), and the Dutch Royal Mail have steamers plying between New York and Europe *via* the West Indies and South America.

It may be mentioned, also, that a trip to the tropics in summer is not at all the trying experience that many persons suppose. Of course, it is hot, and in most parts of the West Indies rainy in summer; but the heat never equals that sometimes experienced along our own Atlantic coast, and, moreover, there are none of the sudden changes that are so trying. The same clothing that is suitable for hot weather in New York will be found quite appropriate for the tropics.

With the great improvements in sanitation of late years there is very little danger from the fevers which formerly gave this region such a bad name. With ordinary precautions, there need be little apprehension on this score.

Having a few weeks at his disposal, the writer decided to go to Europe *via* the West Indies, instead of by the shorter, but infinitely less interesting, route across the northern Atlantic.

Wishing to see something of the South American mainland, it was decided to go first to Paramaribo, the capital of Surinam (Dutch Guiana), as it is possible to go there directly from New York, in about

ten days. From Paramaribo it is two or three days to Trinidad, where one can catch the Royal Mail for England.

The route from New York to the Guianas lies to the eastward of the larger West Indian Islands—the Greater Antilles—and passes close to the line of smaller islands, the Lesser Antilles. These are for the most part extremely mountainous, and the larger ones, like Dominica and Martinique, are exceedingly beautiful, and are also said to be most interesting botanically. Dominica, especially, with mountains rising some 5,000 feet above the sea, and evidently presenting great variety of conditions, made one wish that the ship would stop long enough to enable one to explore the luxuriant forest clothing the steep mountains to their summits.

Passing close to Martinique the sinister bulk of Mt. Pelée dominated the view, and the ruins of St. Pierre could be plainly seen—now after ten years largely overgrown by the rank tropical vegetation which is rapidly covering up the evidences of the great catastrophe.

No stop was made until Barbados was reached. This densely populated island is mainly devoted to the cultivation of sugar, and there is very little forest left. Moreover, unlike most of the West Indian islands, the elevations are comparatively slight, and the conditions much more uniform than in the other islands. To a newcomer in the tropics, however, no doubt the many striking cultivated plants will be a novelty. Some of the showiest flowering trees and shrubs, like the gorgeous flamboyant *Poinciana regia* and the beautiful frangipani (Plumiera), come to special perfection in the gardens of Barbados. Here one sees also the very striking mixture of races found in the West Indies—negroes form a large majority of the population, but there are many East Indian coolies; and a considerable number of Chinese. The white population is insignificant compared with the various colored races.

The next stop was made at Georgetown, the capital of British Guiana, or Demerara. The ship remained all day in port, and there was an opportunity to go on shore and visit the pretty botanical gardens. The town itself is attractively laid out, and the gardens full of luxuriant tropical growths testify to the thoroughly tropical climate. Fine avenues of tall palms are a striking feature of the town. These were apparently mostly the royal palm (*Oreodoxa regia*), but it is not always easy to distinguish this from the even finer cabbage palm (*O. oleracea*).

The botanical garden is really an attractive park rather than a scientifically laid out botanical garden. It contains, however, many fine specimens of palms and other tropical plants which will interest the botanist. Perhaps the finest features of the garden are the extensive

lily ponds, where one can see growing with wonderful luxuriance the *Victoria regia* and other tropical water lilies. A pond full of lotus (Nelumbo) with thousands of white, pink and crimson flowers, was a truly magnificent sight.

Unfortunately, practically none of the original forest has been left in the immediate vicinity of the city, and one must go a long way before one can see the untouched native vegetation.

A day's sail from Demerara brings the traveler to Paramaribo, the capital of Surinam (Dutch Guiana). Paramaribo is a picturesque town, the high-gabled houses with their quaint stoops and doorways looking curiously alien under the shade of great mahogany trees and royal palms. Some of the houses, the former residences of wealthy Dutch merchants, are fine examples of their kind, and recall the flourishing days of the seventeenth and eighteenth centuries when the trade of Surinam was much more important than it is to-day.

The streets are lined with rows of palms and other tropical trees, among which the finest are the gigantic old mahogany trees.

The botanical gardens lie on the edge of the town, and are devoted principally to the cultivation of various economic plants—cocoa, rubber of various kinds, oranges, mangoes, bananas, coffee—and other less known tropical products.

To the botanist, undoubtedly the most interesting feature of the garden is a tract of untouched forest immediately adjoining it. This is an excellent sample of the predominant forest of the region. The greater part of this forest is more or less submerged for much of the time, but at intervals in this swamp are low ridges of more sandy soil, and in these drier areas grow the largest trees, two of which, the silk-cotton (*Ceiba pentandra*) and the sand-box (*Hura crepitans*) are veritable giants. The trunks and branches of these great trees were covered with numerous epiphytes, among which the Bromeliaceæ take first place. Several species of Tillandsia, including the familiar *T. usneoides,* the "Spanish moss" of our own Gulf States, were conspicuous. Clinging to the giant trunks, or festooned from tree to tree, were many lianas, some of great size. Convolvulaceæ, Bignoniaceæ, and especially the giant scandent Aroids—Philodendron, Monstera, Syngonium, and others—were noticeable among the tangle of creepers.

An undergrowth of dwarf palms and many showy Scitamineæ, especially species of Canna and Heliconia, gave the finishing touch to this truly tropical picture.

Almost no ferns were to be seen, and bryophytes—especially liverworts—were few and inconspicuous. Of the latter, only a few small leafy Jungermanniaceæ, growing on the tree trunks, were noted. In the town, and about the garden, a few epiphytic ferns were common.

FIG. 1. FOREST ADJOINING THE BOTANICAL GARDEN, PARAMARIBO.

These included species of Polypodium and Vittaria. This poverty of the fern flora is quite in accord with the account given by Spruce of the forests of the lower Amazon.

Through the kindness of Dr. Cramer, the director of agriculture, and other members of the scientific staff, an opportunity was afforded of visiting a number of the most characteristic regions within reach of Paramaribo, and an excellent idea was thus obtained of the more salient features of the flora of this region. Excursions were made up the Surinam River and some of its tributaries, as well as to one of the characteristic "savannas" occasionally met with in lower Surinam.

Except in the immediate vicinity of Paramaribo there are no roads, and communication (except for one line of railway) is almost entirely by means of boats, which ply along the rivers, creeks and canals with which the whole country is intersected.

Owing to the flatness of the country, the tide extends for a long way up the larger streams, and these rivers are everywhere bordered by an impenetrable mangrove swamp, in the lower reaches of the rivers composed almost exclusively of *Rhizophora mangle,* but higher up, where the salinity of the water is less, the Rhizophora is gradually replaced by *Avicennia nitida,* which sometimes becomes a large tree, whose aerial roots often develop from the upper branches and reach an enormous length. Back of the mangrove belt there sometimes occur slightly elevated ridges upon which the largest trees grow.

Nearly all of the cultivated land in lower Surinam has been reclaimed by building dykes, and the old sluice gates, two or three hundred years old, in some cases, are a characteristic feature in the landscape.

Two of the large plantations were visited, and an opportunity was thus given of seeing the methods in use in the cultivation of the various tropical productions of Surinam—cocoa, coffee, oranges, bananas, cassava, rubber, etc. On one estate there were extensive plantations of Para rubber (*Hevea braziliensis*), and the somewhat primitive, but apparently satisfactory, preparation of the sheets of merchantable rubber could be seen in all stages.

In these large plantations the canals intersecting them in various directions were the principal means of communication, although along the dykes were usually footpaths, which were not always, however, in the best of condition—especially when the clay was slippery after one of the frequently recurring showers.

As the salinity of the water decreases in the upper reaches of the rivers, the mangrove formation is gradually replaced by other trees and shrubs. Several Leguminosæ, especially species of Inga, are common, and great numbers of a big Arum (*Montrichardia arborescens*),

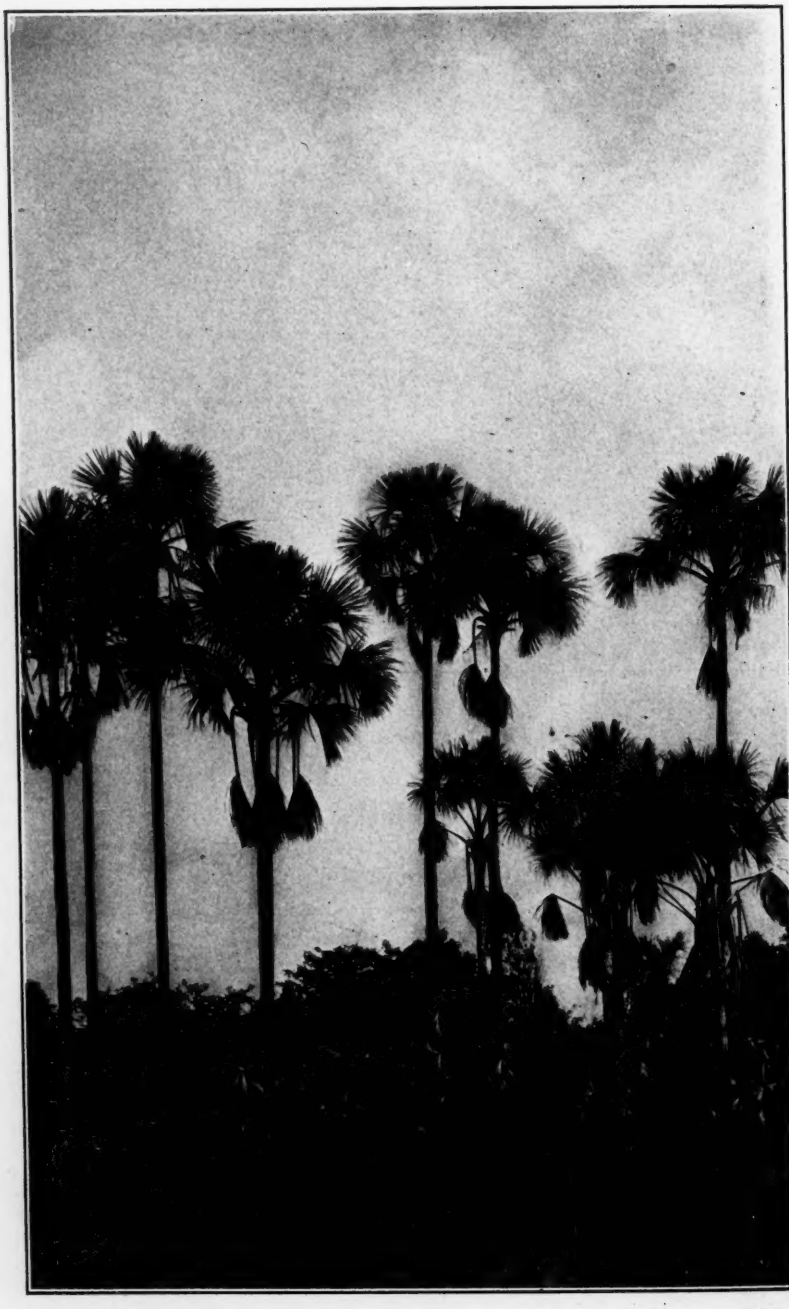

FIG. 2. EDGE OF A FOREST ON THE SURINAM RIVER.
The tall palms are *Euterpe oleracea.*

a constant feature of the brackish and fresh-water swamps, form dense thickets, the crowded bare stems forming a close palisade fringing the margins of the rivers. With the decrease in the salinity of the water, also, palms of various kinds begin to appear, and these constitute quite the most striking growths of the forest along the fresh-water streams. They occur in immense numbers and great variety, and some of them are extremely beautiful. First in abundance—and perhaps also in beauty—is *Euterpe oleracea,* whose slender stems and graceful crowns of feathery leaves occur by thousands. Other conspicuous palms are species of Attalea, Maximiliana, Astrocaryum, Manicaria, and others. Several small palms, especially species of Bactris, occur in great numbers as an undergrowth in these swampy forests. Another striking palm is a Desmoncos, whose flexible thorny stems and graceful pinnate leaves, armed with savage hooked thorns, were festooned from tree to tree. This palm closely resembles the rattan palms of the old world. Its large clusters of scarlet berries were conspicuous, and often attracted attention as the boat skirted the dense mass of vegetation along the shore.

In addition to the many native palms, a number of exotic species are cultivated. Among these are the African oil-palm (*Elæis guinensis*), the royal palm and the cocoanut. The last, however, does not thrive, due perhaps to the excessive moisture in the soil.

A very common and wide-spread member of the tropical American flora is the genus Cecropia, whose slender branches and big palmate leaves occur everywhere.

As might be expected, the development of climbing plants is extremely luxuriant in these wet forests, and in many cases the lower trees and bushes were almost smothered by the dense curtain of creepers of various kinds with which they were draped. These creepers belong to very diverse families—Convolvulaceæ, Passifloraceæ, Apocynaceæ, Melastomaceæ, etc., and many of them have flowers of extraordinary beauty, which add much to the attractiveness of these rich forests.

Very different from the wet forests are the "savannas," one of which was visited. These savannas are in many respects like the moorlands of more northern regions. The soil of the one visited was a coarse sand covered with a sparse growth of coarse grasses and sedges, with scattered clumps of low shrubs, among which were growing a number of orchids. Only one of these, a Catasetum with large greenish flowers, was found in bloom. There were here and there shallow pools, in which were growing tiny yellow Utricularias and minute Eriocaulaceæ and Xyridaceæ. Under the clumps of shrubs were noticed small patches of Sphagnum, and a small species of Drosera closely resembling in form the common D. rotundifolia of

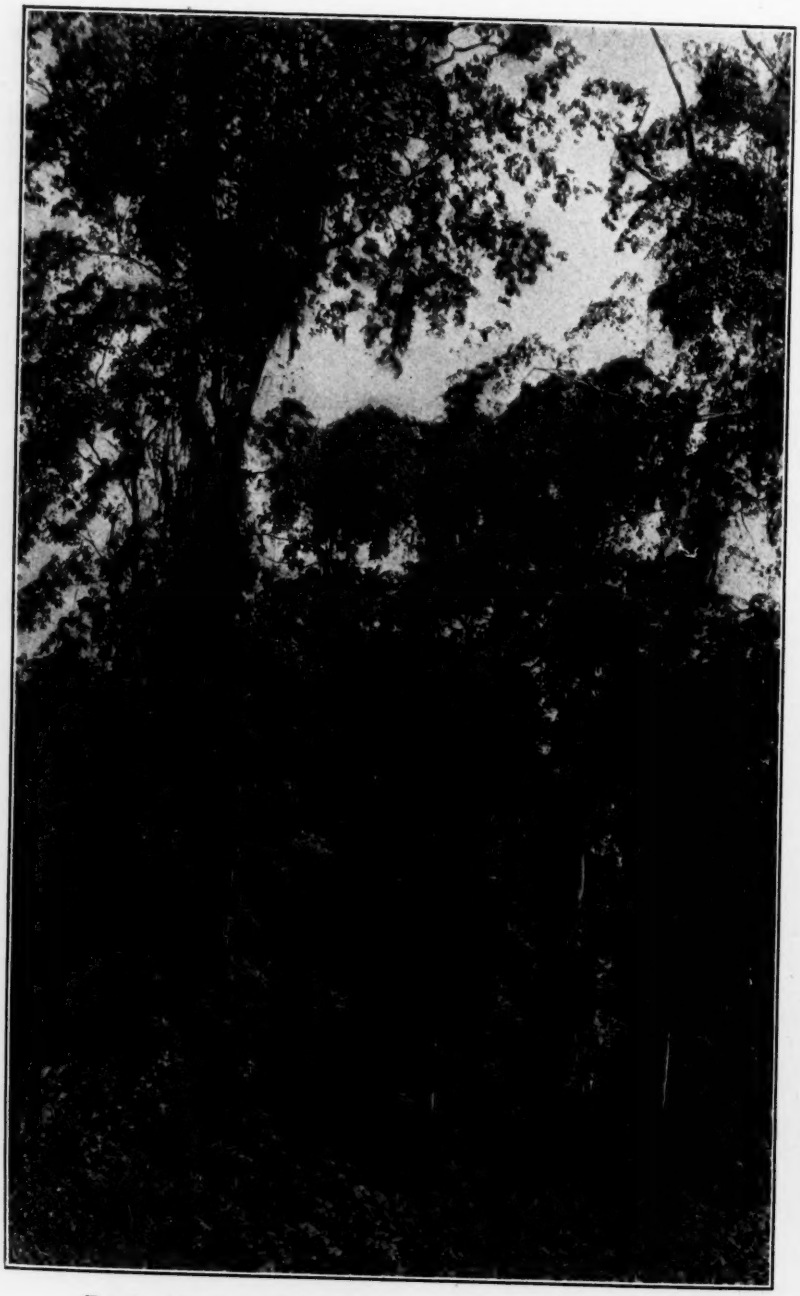

FIG. 3. GROVE OF MAURITIA PALMS IN A SAVANNA, SURINAM.

northern bogs. A very beautiful blue bell-gentian was common. This does not belong to the genus Gentiana, but to a related one, Chilonanthus. A few ferns were noted, among them the ubiquitous *Pteris aquilina.* The shrubby plants belonged mostly to the distinctly tropical families Malpighiaceæ, Melastomaceæ, Rubiaceæ and others.

Among the showiest flowers collected near the savanna, but at the margin of the forest, was an extremely beautiful rubiaceous shrub, which was not determined. Its large rose-colored bell-shaped flowers were produced in great profusion, and were most ornamental. A large purple Clitoria, an extremely showy papilionaceous creeper, was also common.

Much the most striking plant of the savanna, however, is a magnificent fan-palm, *Mauritia flexuosa,* which occurs in groves of considerable size, making a very imposing sight.

Adjoining the savanna was a fairly dense forest, with comparatively dry soil, although there were numerous clear streams, deep amber brown in color, and in places it was decidedly boggy. As in all the forests, the palms formed the most conspicuous feature of the undergrowth. Ferns and liverworts were more abundant than in the forests near Paramaribo, and at the base of some of the trees a small Trichomanes was not uncommon, the only Hymenophyllaceæ that were collected. An interesting tree of this forest was the "Balata," a species of Mimusops which yields rubber of fair quality, which is collected in considerable quantities by the natives. There also occurs a species of Hevea, which, however, is much inferior in its product to the Para rubber tree. A not uncommon plant of this forest—and also seen repeatedly elsewhere—is *Ravenala Guianensis,* much resembling the well-known "traveller's palm," *R. Madagascariensis.* There was also the usual profusion of other Scitamineæ.

The flora of Surinam is remarkable for the abundance of showy flowers—not a usual condition of things in the wet tropics. Among the most conspicuous of these are many splendid climbing plants—especially various Bignoniaceæ, Apocynaceæ, Convolvulaceæ and Passifloraceæ. Some of these, like the golden yellow Allamandas and crimson and rose-colored passion flowers, were truly magnificent. There were also many showy shrubs, especially various Rubiaceæ, Malpighiaceæ and Melastomaceæ.

Of the herbaceous plants probably the showiest are the very abundant *Heliconias.* These look much like Cannas—or the larger ones like bananas—and their scarlet and yellow inflorescences are extremely brilliant. There were also great masses of red and yellow Cannas, and other showy Scitamineæ—*e. g.,* Costus, Maranta, Thalia, etc. These brilliant flowers occurred in great masses along the margins of the forest, and the railway embankment was a veritable botanical garden.

Associated with these distinctly tropical plants were a number of more familiar aspect. The well-known red and yellow *Asclepias curassavica* was extremely common, and several species of Verbenaceæ and Compositæ were quite like northern forms.

Next to the palms, perhaps the most characteristic plants are the Araceæ, which occur in great number and variety. Besides those already referred to, perhaps the most noticeable were species of Caladium, whose brightly colored leaves were a common feature of low ground everywhere.

Of the epiphytic plants, the Bromeliaceæ take first place. There are also many species which grow upon the ground and closely resemble pineapples in their general appearance.

Surinam is not specially rich in orchids, and of these very few were in flower when the writer visited the country. The most interesting form encountered was a species of Catasetum (*C. fuliginosum*), already referred to.

As might be expected, aquatic plants are very numerous. Owing to an abnormally dry season prevailing during the early part of the year which dried up many bodies of water, comparatively few of these were in flower. Azolla was abundant in the ditches and canals, and also a species of Salvinia. The leaves of water lilies were abundant, but no flowers were seen. About the margins of ponds were sometimes seen the big white flowers of *Hymenocallis obtusata,* looking like white lilies.

Although Trinidad is reckoned with the West Indies, its flora is very different from that of the Antilles, and is essentially South American in type. Trinidad is separated from the mainland of Venezuela by only a few miles and the plants are largely the same as those in the adjoining regions of Venezuela and have much in common with those of the Guianas.

During a stay of two weeks the writer visited only the northern part of the island. This is, however, the most interesting portion of Trinidad, as not only are the highest mountains here, but there is also a fine development of lowland forest, and a savanna formation much like that seen in Surinam.

Port of Spain is perhaps the most attractive of the West Indian towns, and offers much of interest to the botanist—both in the town itself and in the environs. The botanical garden in Trinidad is the best in the West Indies, and in addition to the many fine examples of tropical plants cultivated in the garden there is adjoining it a considerable tract of practically untouched jungle, which is easily accessible and is full of interest to the visiting botanist. The garden is now under the direction of Mr. W. Freeman, to whom the writer is under obligations for much kind assistance during his stay in Trinidad.

Close to the old botanical garden is the more recently laid out

agricultural experiment station, where are to be seen many varieties of the principal tropical fruits, especially oranges and mangoes. The latter are especially fine in Trinidad.

Among the most striking features of the botanical garden are the palms, of which there are many magnificent specimens, both native and exotic. In the town itself palms are planted in great numbers, especially the stately cabbage palm "palmiste" of the French creoles, probably the finest of all palms. It is a common sight to see clumps of epiphytic orchids attached to the trunks of trees in the gardens of Port of Spain. These are said to be very beautiful during the early winter, but in July only a very few were in blossom.

In Port of Spain there are magnificent trees in the parks and gardens and along the roads. These are often of enormous size, and their branches are frequently covered with epiphytes of various kinds, among which the most conspicuous are the Bromeliads, and the curious *Rhipsalis Cassytha,* a member of the Cactaceæ, but very different from most of the family. This plant grows in immense pendent masses, sometimes ten feet or more in length, and is exceedingly common in Trinidad. Of the numerous large trees, the silk-cotton (Ceiba), the West Indian cedar (*Cedrela odorata*), and the sand-box (*Hura crepitans*) were the commonest of the native species; but mahogany trees of large size, and gigantic specimens of *Pithecolobium Saman,* are frequently seen. A very curious native tree, *Couropita guianensis,* is sometimes seen planted. This produces many short branches from the main trunk, upon which the large red flowers are borne in great numbers. These are followed by enormous globular fruits of such size as to fairly entitle the tree to its popular name, "cannon-ball" tree. Space will not permit of any further enumeration of the beautiful and curious plants with which the gardens are filled.

Much of the country about Port of Spain is still but little disturbed, and even where it has been cleared, the neglected land soon reverts to jungle. The wetter lowlands abound in palms, Aroids, Scitamineæ, etc., much the same types that occur in the Guiana forest. The drier hillsides, however, show a good many forms different from those of the lower levels. A very common palm of the dry hillsides is *Acrocomia sclerocarpa,* a species common to the Antilles also, and very common in Jamaica. A very showy shrub of this region is a rubiaceous plant, *Warscewiczia coccinea.* In this plant, as in the related Mussaenda of the eastern tropics, one of the calyx lobes is much enlarged and petal-like in color and texture. In Mussaenda this is white, but in Warscewiczia it is a vivid carmine red, and the whole inflorescence strongly suggests the familiar poinsettia—indeed the plant is locally known as wild poinsettia.

Ferns are much commoner in Trinidad than in Guiana, although

at the lower levels they are not especially notable. Two species of Schizæaceæ were common near Port of Spain—a Lygodium sp. and *Anemia phyllitidis.*

A visit to a small waterfall a few miles away yielded a considerable number of ferns, including some small Hymenophyllaceæ and a Dancea, and also several interesting liverworts. In the botanical garden were also found two interesting liverworts, a large Riccia and a Notothylas (?).

While driving to the waterfall a fine white arum (*Spathiphyllum cannæfolium*) was seen in great numbers along the river, and the trail to the falls led through a fine forest with tall trees and a luxuriant undergrowth of large ferns, some of which were small tree-ferns. There were also many Aroids, some of great size—Montrichardia sp., Philodendron, Anthurium, etc. Some very showy Bromeliads, with fine scarlet bracts, were common as epiphytes, and also a good many orchids; but some of the latter were in flower. These, with the gorgeous Warsczewiczia and masses of the fine *Heliconia Bihæ,* made a magnificent picture of tropical vegetation in its most luxuriant aspect.

Small tree ferns (species of Alsophila and Hemitelia) were fairly abundant, and several young specimens of a Danæa were found on a wet bank, where there was also found a luxuriant growth of several interesting liverworts. The latter included species of Aneura, Metzgeria, Symphyogyna (?), Fossombronia and Dumortiera.

In company with Mr. Freeman, assistant director of agriculture, a very interesting excursion was made to the Aripa savanna, some 25 miles from Port of Spain. This savanna was in many respects like the one visited in Surinam, but the vegetation was more luxuriant. There were similar groves of Mauritia, but even a finer species (*M. setigera*). A number of beautiful ground orchids were found in flower, and a small Drosera, different from that found in Surinam, was common. Tiny Utricularias with yellow and purple flowers were abundant, and as in the Surinam savannas, there were clumps of low bushes, largely Melastomaceæ and Malpighiaceæ, in the shelter of which was found a very interesting fern, *Schizæa pennula,* as well as several other ferns. Two species of *Lycopodium, L. cernuum* and *L. Carolinianum,* were common.

The forest adjoining the savanna was very beautiful, with fine palms—Euterpe, Bactris, Attalea, Maximiliana, and others. A Commelynaceous plant with yellow flowers was very abundant (the same species was also seen in Surinam) and there were the usual abundant epiphytic orchids and Bromeliads, as well as a number of small Hymenophyllaceæ.

In these woods were many specimens of a Clusia, growing first as an epiphyte, and sending down aerial roots, which finally completely strangle the tree upon which the Clusia has fastened itself. These

parasitic trees, with their glossy magnolia-like leaves are extremely handsome, and much resemble in general appearance the species of Ficus, so common in the eastern tropics, which have the same habit of strangling the tree which gives them support.

Trinidad has no very lofty mountains, the highest peak, Tucuche, being very little over 3,000 feet. The most interesting excursion made was to this mountain. In company with Mr. Freeman, Mr. Urich, the government entomologist, and Mr. Chandler, an English botanist visiting Trinidad, the writer made the ascent of the mountain which offers no difficulties, and many interesting plants not found in the lower country were seen.

The route at first lay through extensive cocoa plantations, which occupy much of the lower forest lands in Trinidad. Along the margins of the streams the showy Aroid, *Spathiphyllum cannæfolium,* made a fine show, and another conspicuous and interesting plant was the curious *Cyclanthus bipartitus,* a member of the small family Cyclanthaceæ, whose systematic position is something of a puzzle to the systematist.

Lygodium sp. and *Anemia phyllitidis,* characteristic ferns of the lower country, were abundant, and a number of other ferns were noted as well as a few liverworts. These, however, are much better developed at higher elevations where there are a number of species of tree ferns belonging to the genera Alsophila, Cyathea and Hemitelia. None of these attain large proportions, and neither in the number of species nor in the size of individuals can Trinidad compare with Jamaica.

At an elevation of about 1,500 feet the primitive forest begins—characterized by magnificent tall trees, whose species in most cases could not be determined. The dense undergrowth comprised large ferns, palms, Heliconia, Araceæ of various kinds, and many shrubs and lianas, the whole forming a magnificent example of a wet tropical forest. That it was a "rain forest" we thoroughly appreciated, as we passed through it in a veritable tropical downpour which soon made every little ravine and gulley the bed of a torrent, and much of the time we had to wade through these small cascades when they crossed the trail.

However, although thoroughly drenched, we finally reached the summit where there is a shelter hut in which we were to pass the night. The rain ceased for the time being, and after a change into dry clothes the afternoon was spent exploring the upper part of the mountain.

Among the most noticeable plants of the summit were many Bromeliaceæ, mostly epiphytes, but some of them growing on the ground. The scarlet and yellow bracts of some of these were extremely showy. Several species of palms were abundant, and especially *Geonoma sp.* confined to the higher elevations. One of the most beauti-

ful plants met with was a species of Utricularia, *U. montana,* sometimes seen in cultivation. Unlike most of the genus, this is an epiphyte, and the drooping racemes of big white flowers might very well be mistaken for an orchid.

As is usual at the higher elevations in the tropics, the lower plants are relatively more abundant than at lower elevations. Besides, the tree ferns there were many others, including several Hymenophyllaceæ and two species of Danæa, which were growing abundantly upon the wet banks, and whose large liverwort-like prothallia were found in quantity. The wet banks also yielded a fair number of liverworts, and at the very summit the ubiquitous *Lycopodium cernuum* was abundant. Mosses and lichens also abounded, but no notes were made of the species.

To the botanist visiting this region for the first time, the abundance and variety of the palms will first attract attention. Many of them are exceptionally beautiful, and they often grow in large masses giving a characteristic stamp to the forest vegetation. Palms are a far more conspicuous feature in the South American tropical forest than in any part of the eastern tropics with which the writer is acquainted. The Araceæ, also, are more numerous and varied than in the tropics of the old world, and none of the old-world forms can rival the giant scandent genera, like Philodendron and Monstera, which are so characteristic of the American tropical forests.

Of the numerous Scitamineæ the common Heliconias with their gorgeous inflorescences will first attract attention, and of course the peculiarly American family, Bromeliaceæ, will be of special interest to the European visitor.

The prevalence of showy flowers in Surinam was noteworthy, as this is not a common feature in the wet tropics, a fact frequently commented on by scientific travelers. Whether or not the two go together, it may be mentioned that in Surinam there is also an extraordinary abundance of brilliant butterflies, some of them of wonderful beauty.

In Trinidad the prevalence of showy flowers was much less marked than in Surinam, although it is by no means deficient in striking flowers. As has already been stated, Trinidad in the main features of its flora belongs rather with the continental region of South America than with the other islands of the West Indies.

A GRAIN OF WHEAT[1]

By R. CHODAT

PROFESSOR OF BOTANY AT THE UNIVERSITY OF GENEVA, SWITZERLAND

PEOPLES truly rich are those who cultivate cereals on a large scale. Scores of investigators in all civilized countries devote themselves unceasingly to a problem of great social significance, viz., the increase of the national wealth through progress in agriculture. The least discovery in this field, whatever the political journals may say, is more important for a country than a change of the party in power. For it is the history of discoveries and inventions—in the domain of nature, as well as in the intellectual field—that constitutes the real history of civilizations.

Thus the modern improvements in the industry of milling in connection with better transportation facilities have helped to provide better bread for all classes and have rendered famine impossible in the Europe of to-day.

Is it then any wonder that since the most remote antiquity germinating wheat has been the symbol of mysterious and hidden life, that in their religious ceremonies the ancients attached so much importance to cereals offered on the altar, that our modern artists, putting aside the petty themes of political events, have glorified the beauty and nobility of harvests, the poetry and mystery of sowing, in justly renowned paintings? Roty's admirable sower on the French coins, who symbolizes the value of this idea, shows us the highest art seeking its inspiration at the very source of civilization—the culture of wheat.

I do not wish to overtax your attention or indulge overmuch in scientific pedantry by enumerating to you, together with their botanical characteristics, the different kinds of wheat which have been and are still cultivated. I shall merely give you as much as is essential for my purpose. The most competent botanists in this field agree in recognizing at least three species of wheat:

1. Einkorn (*Triticum monococcum*).
2. Polish wheat (*Triticum polonicum*).
3. Wheat (*Triticum sativum*).

These distinctions are based not only on morphological characters, but also on a character which is accepted on good grounds as usually

[1] Presented before the General Meeting of the Société des Arts, Geneva, Switzerland. Translated from the French by Maude Kellerman.

separating species from varieties, that is, their sterility when crossed among themselves, or their failure to produce fertile offspring. Attempts to cross these types have never given results.

Ordinary wheat may be divided into numerous varieties or subspecies, reciprocally fertile, which are grouped about the following subspecies:

Emmer (*T. dicoccum*).
Spelt (*T. spelta*).
Wheat proper (*T. tenax*).

The first two subspecies differ from the third in that the ear has a fragile rachis and the grains remain covered by glumes which must be removed by a somewhat complicated process, whereas in the third species the grains on ripening fall from the ear the rachis of which is not articulated. I shall give here only what is most essential for the understanding of what is to follow. Now, it is evident that emmer and spelt are inferior to true wheat because of the fragility of the rachis of the ear and because of their enclosed grains. Whenever it is possible wheat is grown instead of emmer or spelt.

Not to prolong the discussion of these classifications, let us say at once that wheat proper is represented in cultivation in various parts of the world by a considerable number of varieties, but it is difficult even for the specialist to distinguish them. One of these varieties, having a non-articulated rachis (*Triticum durum*), the hard wheat of the Mediterranean countries, is so closely related to emmer that the systematic affinity of the wheats with an articulated rachis and those with a non-articulated rachis can not be questioned.[2] Each year, in agricultural experiment stations organized according to the principles of Vilmorin, Rimpau or Svalöf, new races are brought to light and are tested out in suitable soils and climates. I do not wish to tire you by a dry enumeration of all these forms; even had I the time for it I should not be competent to perform this task.

Which of all these varieties of cereals first appeared in cultivation? To this question we may reply that it is certain to-day that emmer was cultivated by the Egyptians from the time of the first dynasty, or about 6,000 years ago. The glumes preserved in the tombs show that the grain was already at that time freed from its envelopes by the use of special machines; it was not simply flailed or tramped out by cattle. Einkorn and emmer have also been found among the débris of the granaries of the lake-dwellers of Switzerland. Hard wheat, which of all the kinds of wheat proper most nearly resembles emmer, has also been cultivated in Egypt since very ancient times. If we regard the

[2] Aaronsohn, Aaron, "Agricultural and Botanical Explorations in Palestine," Bulletin No. 180, United States Department of Agriculture, 1910, Bureau of Plant Industry, 64 pp., 9 pls., 12 text figures.

matter from an evolutionary standpoint, according to which related races, varieties and species had a common origin, we can arrive logically at but one conclusion, namely, that the most ancient wheats were those with a fragile rachis. One arrives at the same conclusion on comparing the cultivated barley, having an articulated rachis, with the wild barley which has a fragile rachis.

The well-preserved emmer glumes in this bottle which I am going to have passed around were found at Abusir in the tomb of the king Newoser-re (Dyn. v. 2400 B.C.). This material was very kindly sent me by the Oriental Society of Berlin.

If, on the other hand, we look to Europe and Asia to see in which countries these ancient cereals are still cultivated, we shall find them in the northern Jura, in the countries of the Basques, the Servians, the Swabians and the Bactrians of Persia. We see that these cereals have maintained themselves only in mountainous countries or among the peoples most remote from the centers of civilization. The cultivation of emmer has long since disappeared from the fertile plains of Egypt, where it was superseded by that of hard wheat.

Knowing, therefore, that the wheats cultivated in most ancient times were those with a fragile rachis, we are confronted by a second question: Where is the home of this type of wheat? In what country did our first parents, our prehistoric ancestors, find this plant, most precious of all plants?

As for the einkorn, we know its home since the botanist Balansa found it in Asia Minor. It is true that Balansa's wild plant differs from the cultivated einkorn in certain characters and it has been named *Triticum monococcum,* var. *ægilipoides.* But it has already been noted that this species is too distinct from wheats to allow it to be considered as their prototype.

For more than a century botanists and historians of civilization have sought for the home of wheat. In vain have all the resources of comparative morphology been employed, as well as those of history and philology. The origin of wheat remains shrouded in mystery. The ancients attributed its introduction into the world of men to some beneficent goddess, thus putting the mystery of its first cultivation back of all written history.

A botanist of great merit, Count Solms Laubach, weary of this discussion, finally advocated the idea that the wheat of the present day, with its numerous varieties, might be the descendant of plants which have to-day disappeared, either because their home was submerged by the sea or because they were the result of a convergence of several species deviating in the same direction or mixed in cultivation, which would make the determination of their origin almost impossible.

In the universities the view has generally been held that the home

of the wheat would always remain unknown and that our cultivated species had been so greatly modified by cultivation that they scarcely resembled the wild species which served our prehistoric parents in their conscious or unconscious attempts at artificial selection. This transformation, it was said, had required ages of time, and it was not overlooked that it had also required extraordinary perspicacity on the part of these half savages who succeeded in producing from an insignificant grass the vigorous and precious cereal of to-day. It was admitted, thus, that prehistoric man was endowed with a divining sense more remarkable than that of the scientists of the present time, who, in the domain of agriculture, have never achieved results equal to this. To support this idea it might be maintained that the more primitive the people the more acute is its sense of observation. Book science very often sterilizes the excellent mentality natural to youth and also limits the imagination.

However, I remember that when for the first time I found wild cabbage growing on rocks at the seashore remote from all cultivated fields, I was struck by the fact that even with my limitations of an educated man and with all the mental deformation attendant on scientific specialization which leads one away, they say, from common sense, I should nevertheless, it seemed to me, not have hesitated, in case of need, to try this plant as food, so inviting was its appearance. Last year, in my botanical trip along the coast of Portugal, I was able to see that the Portuguese peasant, who has kept so many vestiges of the past in his dress, his domestic animals (long-horned cattle), his cart and his customs, still uses the cabbage (Covo-gallego) as primitive peoples would; the flower tops are simply boiled. There is a far cry from this cabbage still so near its primitive state to the numerous varieties which the agriculturists have introduced into our European cultivation.

There is, then, reason to believe that primitive man found the plants suitable for cultivation already showing the principal attributes which make them useful; he found the cereals, he did not create them. In other words, cereals are the cause of civilization, not civilization the cause of cereals.

Alphonse de Candolle, the illustrious father of the president of the Société des Arts, in his classic work on the origin of cultivated plants, in 1883, says:

> The Euphrates region, lying about in the middle of the zone of cultivation [of wheat] which formerly extended from China to the Canary Islands, was very probably the principal habitat of the species in very early prehistoric times. Perhaps it extended towards Syria, as the climate is very similar, but to the east and to the west of western Asia wheat has never existed except in a cultivated state, antedating, it is true, any known civilization.

This brings us to the main issue of the question which I wish to study with you.

About 1902 two German botanists, well known in Geneva, Ascherson and Schweinfurth, called the attention of a young agronomist, Mr. Aaron Aaronsohn, who was destined in later years to become director of the Haifa Agricultural Station in Palestine, to the scientific and historic interest of determining the truth of a suggestion made by Kotschy. This collector brought back from Syria a fragment of a wild plant which Körnicke, an authority on cereals, recognized as a form of *Triticum dicoccum* and which he made a variety under the name of *T. dicoccum dicoccoides.*

From this mere indication Körnicke drew the same conclusions as those A. de Candolle had reached by another road, *i. e.,* that wheat must be indigenous to Syria. In the course of a geognostic expedition in Upper Galilee to the north of Lake Tiberias, Mr. Aaronsohn gave his attention to this question, although he was very dubious about being able to answer it.

As a matter of fact, modern botanists who have studied the flora of Syria, such as Dr. Post, have not confirmed Kotschy's doubtful indication. On the first expedition Mr. Aaronsohn found nothing, but urged by his friends in Berlin he went to this same region again, and this time his efforts were crowned with success. In June, 1906, being at the north of Lake Tiberias at Rosh Pinah, he found a single specimen of the wild emmer (*Triticum dicoccum dicoccoides*) growing in a rocky fissure. Complete success came, however, only on leaving Rasheya, where wild wheat abounded in uncultivated ground. Having climbed Mt. Hermon, he descended on the opposite side, and towards the village of Arny wild wheat was also very common and showed here an extraordinary variety of forms; black glumes or only partly black, black or colorless heads, smooth or hirsute glumes, glumes sometimes resembling those of *Triticum monococcum* (einkorn) or *Triticum durum* (hard wheat), heads of the type of *T. polonicum,* etc. Among these plants there was also the wild einkorn (*T. monococcum ægilipoides.* This excessive variation, the abundance of these plants, their distribution on the slopes of Mt. Hermon from an altitude of 1,500–2,000 m., all show that the plant is certainly indigenous. It is a known fact that our cereals do not spread beyond cultivation in any country and that however extended their cultivation may be they never become subspontaneous. In order to establish itself in any locality a plant must hold its own against competitors which, masters of the soil from time immemorial, have been selected to fit the soil and climate. Moreover, emmer is not cultivated anywhere in Palestine. This wild wheat is furthermore a different plant from any known in cultivation, a polymorphous race, no doubt, but a distinct

one, to which Körnicke had already given the varietal name *dicoccoides*. No intermediate form between this wild plant and those cultivated in Palestine has been found. Thus everything tends to show that wheat is indigenous to Mt. Hermon. Somewhat later, Mr. Aaronsohn discovered *Secale montanum*, the wild rye, in Antiliban. For philological reasons it had formerly been thought that this was indigenous to Europe. From now on we must bear in mind that this cereal also has its center of distribution somewhere in Asia Minor.

That wheat was indigenous to Palestine was to be confirmed somewhat later by the same explorer. In 1908, while on a mission for the Turkish government, Mr. Aaronsohn discovered wild barley, already known at other stations, in the Moab country on the left bank of the Dead Sea, above El Mazra-a; towards Wady Wahleh monoliths occur in large numbers and round about are many chipped flint implements. The Jewish savant could not keep his fancy from roaming. He went back in spirit to that far-away epoch, more ancient than all written history, when urged by hunger while crossing these steppes, primitive man first tried these savory grains and discovered cereals.

A little later in this same region of the Dead Sea, while on a second expedition, Mr. Aaronsohn found emmer in great abundance, towards Tel Nimrim, in the valley of the Jordan, at Ain-Hummar, on the plateau of Es-Salt.

When one considers the fact that the grains of wild wheat are not inferior either in weight or size to those of the best cultivated species it would be impossible not to arrive at the conclusion that primitive man did not create cereals, he found them.

One can imagine the nomads of the hills and mountains of Palestine, giving these precious seeds to the inhabitants of Mesopotamia, who were better situated than themselves for the testing of crops and who succeeded with them in their rich alluvial plains. Glancing at the Assyrian bas-relief, we are struck by the great importance given by this people in their ceremonies to the mystery of the seed which contains within itself the essence of life and, in consequence, the intense interest which they manifested in all agriculture.

One of the most striking things in economic history is the rapidity with which a new food or useful plant spreads even to little-civilized countries. Schweinfurth, in his famous voyages to the heart of Africa, found tobacco grown by the most primitive peoples. Hooker, exploring the high valleys of the Himalayas, found the potato cultivated by the Lepchas and the people of Nepaul, scarcely half a century after its introduction into Europe as an important cultivated plant.

I have told in detail of the important discovery of Aaronsohn. Let us see now what practical and scientific results can come from it.

In order to do so it is necessary to explain to you as briefly as possible the present state of biological science and the modern way of considering the problems relating to species.

Modern botany, abandoning the ancient methods which depend more on metaphysics and speculation than on experiments, has given up the idea of discovering the origin of species by the prevalent method of comparison and reasoning. The separation of forms, of varieties and of species, as it is made by systematists, the herbarium specialists, is based on judgment; it depends essentially on the degree of intuition of the botanist who compares and draws conclusions. I do not mean to say here that the methods of this science are conjectural, but I may be permitted to say that it is only an outline of a science, that it is provisional knowledge, a first attempt at classification. More precise methods are necessary in order to resolve serious biological questions. The best representatives of contemporary biological science are much less hurried than their predecessors; they have acquired the conviction that there is no short cut to truth. The scientific highway is paved with difficulties. In this explanation, then, I shall not touch upon the evolutionary speculations of Darwin or others, but shall give my time exclusively to exact data.

Contemporary biology accepts the constancy of types as a well-established fact. It has discovered that this constancy is experimentally demonstrable if the following facts, not known to Darwin and his followers, be taken into account.

Every species in its natural state, and often even in cultivation, includes a large number of forms which were formerly considered variations, but which, analyzed by modern methods, appear to be constant types, all of which taken together form the Linnean species. In order to discover these small constant species which ordinarily live mixed together, it is necessary to segregate them. Vilmorin had already recognized that unequivocal results could not be obtained in the study of variation if one starts with an isolated plant or even with a single seed. A single grain of wheat may be the ancestor of innumerable generations. If these isolated grains, carefully catalogued, be sown separately, it is seen that they give birth to constant races or lines which are called pure, because they are without mixture. To evaluate these lines and differentiate them from other lines, we must not consider the isolated individual, but rather note the character of the descendants as a whole by means of experimental pure cultures. The individuals of the same race, of the same line, may differ very much according to their age, nutrition, position during the embryonic or ontogenic development, but their descendants taken as a whole are identical. In a pure race, the dwarfs as well as the giants give birth

to a mediocre line having the same average size (and other values which I can not cite here). In other words, the sum of the descendants is identical with the sum of the ascendants.

Each race differs from the others in form, stature, hardiness and chemical composition. The name population has been given to the mixtures of races, such as nature gives us in a meadow or such as we have in cultivation when segregation has not been carried far enough, that is to say, when pure lines which can be distinguished have not been separated grain by grain. This practise of selection, according to Vilmorin, has already been tested not only in the vast field of theoretical botany, but also in that of applied botany. At Svalöf, Sweden, cereals are selected according to this principle by evaluating the differences by numerical methods. All agricultural Europe follows with special attention the classic experiments of Nilson and his collaborators.

Except for the very rare phenomenon of spontaneous variation (mutation) we can by beginning with these pure lines operate in a practical way, with almost mathematical certainty, the probable error being minimal. In cereals, and especially in wheat, the characters to be studied which will be constant for a given race are: stooling, regularity of growth (that is, greater or less individual variation), average weight of the grains, resistance of the straw to lodging, length of the straw, form and length of the heads, composition of the grain (starch, sugar, nitrogen, fat, etc.), disease-resistance. In the short time at my disposal I can not explain to you the ingenious methods used to determine with precision these different characters. I wish to add only one thing. Each of these characters or their combination in pairs or groups determines the probability of success and good harvest in a given locality, and, in consequence, the more constant forms, the more pure lines there are, the more prepared will scientific agriculture be to furnish to cultivators races which will suit their soils. Now if you consider that these problems are among those that chiefly interest mankind, which demands each day its daily bread, you will understand that the slightest discovery which makes for the betterment of cereals means a noticeable increase in the wealth of a nation. If France is one of the richest countries of the world it is because her wheat production is superior, in respect to her territory, to that of all her competitors.

Now, modern agriculture, given new life by botany, has obtained in France, Germany and other civilized countries, a considerable number of these varieties, starting from cereals introduced into our country in the course of the long history of civilization; that is, from times more ancient than any documents written on parchment or carved in stone.

But let us remember the important results of Aaronsohn's discoveries: Primitive man, even he who chipped the flints abounding about the menhirs of the Moab country, as he sought his food in the steppes, found fields of cereals waving in the breeze just as the graceful heads of *Stipa* sway in the breeze of our fields of our canton of Valais. The wild wheat, *Triticum dicoccoides,* with its large grains, must have immediately caught the attention of a primitive people, interested in nature as are all peoples whose eyes have not been closed and whose sense of observation has not been dulled by too much book learning.

Is it not a singular coincidence that this young Jew, Mr. Aaronsohn, should rediscover in Judea the origin of our cereals, of our civilization? There is material in that for a philosopher or a historian to write a moving page. I have the pleasure of counting Mr. Aaronsohn among my botanical friends, and I may say to you that rarely has an important discovery been made by a more genial and charming man. Those who say that man is master of his fate may well cite him as an example. But let us rather listen to him:

JEWISH AGRICULTURAL EXPERIMENT STATION
HAIFA, PALESTINE

26 Jan., 1911

MONSIEUR CHODAT,

Professeur à la Faculté des Sciences, Genève.

Dear Sir: I have just received your kind letter of the 3d inst., which recalled to me our agreeable and interesting conversations during the Congress at Brussels. I am very much flattered to learn of the subject that you have chosen for the annual meeting of the Société des Arts.

I shall be glad to send you the "corps du délit" which you wish; I shall also take the liberty of sending some photographs taken last June which will give you an idea of the appearance of the fields where my *Triticum* flourishes. You will doubtless be glad to learn that we have this year sown more than an acre of *Triticum dicoccoides.* We intend to study the value of this plant for forage, etc. I had the good fortune to discover in Upper Galilee this year a spontaneous hybrid of *Triticum* and *Ægilops,* and there also exists already a wheat with a non-articulate rachis, arising from a cross of my *Triticum* and a cultivated wheat. Thus you see that we are rapidly advancing towards the realization of our dream. In the different experimental fields where my *Triticum* has been grown it has resisted rust very well, and this for three or four successive years while many check varieties succumbed to this disease. In these times of "unit characters" it should not be difficult to fix this special property of disease-resistance, and you will at once realize the practical significance and the economic value of this character.

As for the problem of the origin of civilization or the origin of wheat culture, I have resolved upon a new method of attack. I had first taken up the study of adventitious plants accompanying our cereals. Thus the discovery of *Lolium temulentum,* quite spontaneous in a given region, far from all cultiva tion, would be a sufficient reason, in my opinion, for inaugurating a search in this neighborhood for the cradle of our cereals. Now, I am on another trail.

I wish to study the cryptogamic diseases of my wild wheat in order to try to discover if among them there are any peculiar to wheat in other regions and which here would attack other plants. We could then say this or that cryptogam was carried by cereals and would be found in the same situation in relation to wheat, as certain phanerogamic satellites such as *Lolium temulentum, Githago segetum*, etc., etc.

I am sending with this letter a small photograph showing our workmen sowing *Triticum dicoccoides* with a drill. I shall not conceal from you that I am very proud that when for the first time since prehistoric times man has again tried sowing the prototype of wheat, this work has fallen to Jews (escaped from the ignoble massacres of Russia), Jewish teams working on Jewish ground, the historic cradle of the race.

Yours sincerely,

A. AARONSOHN

You perceive the wide field which this discovery has opened up. The utilization for new needs of new races of wheat to be segregated from this wild material, that is, from the polymorphic plant populations of the hills of Judea, the extension of the cultivation of cereals to arid regions or mountainous zones, where it has hitherto not been possible.

But there is more than that. We possess now, and Mr. Aaronsohn alludes to it in his letter, a second method of improving wheat by the method of selection, growing pure races from single seeds.

We can, by crossing, create new races and in this domain modern methods have a startling precision. They say that the man who suddenly had a new world revealed to him by the microscope lost his reason. To-day, placed in the presence of the facts brought to light by modern biological analysis, we can see in our minds an infinite line of discoveries which were not even suspected by the generations preceding us.

Here, in a few words, are the results already obtained:

They lead us to suppose the existence of essential representative particles within the germ cells of plants. These particles may be compared to the atoms which chemists suppose to exist in the inanimate world. These are the biological elements, the "organic corpuscles" as Buffon would have called them. We call them "gens." The body of the plant with its diverse characters is then only the exterior manifestation of these "determinants." We suppose, then, that each character manifested is determined by a "gen," a "determinant." To constitute an organism with its characters there must be an association of gens.

For the sake of similarity in studies on heredity plants belonging to the same systematic grouping, the same genus or the same species, are usually compared. Only the characters in which these two plants differ are taken into account. For example, a race X will differ from

a race *Y* by three characters, *i. e.*, by the gens *A B C* (for example, *A* = long head; *B* = awned glumes; *C* = rust resistance), to which the race *Y* opposes *a b c*. These are antagonistic characters (*a* = short head; *b* = awnless glumes; *c* = capacity for rust infection). *A* is the antagonist of *a*, *B* of *b*, etc. But *A* is not antagonistic to *b* or *c*, nor *B* to *a* and *c*.

As long as the plant is self-fertilized, the mosaic of its characters is maintained. But if it is fertilized by a distinct race several cases can arise in the course of successive generations. The product called a hybrid (F_1 = filius 1) is evidently the sum of the two parents ($X + Y$); if forms not closely related to each other are crossed, the hybrid generally takes a form intermediate between the two parents. We shall not speak of these hybrids here, for they are generally sterile and practically useless for cereal culture. If, on the other hand, closely related forms are fused in the hybrid (F_1) the characters of the father or the mother exclude those of the other parent; one of the parents seems to have been absorbed by the other. Then we say that the character of the father or of the mother dominates or *vice versa*. Let us take two parents *X* and *Y*, differing in the antagonistic characters *A B C* for *X* and *a b c* for *Y*. The hybrid ($F_1 = X + Y$) will have the appearance *A, B, C*, if the total gens of *X* dominate those of *Y*, or the appearance *a, b, c* in the contrary case. In other words, one of the parents may seem to be absorbed by the other. But it often happens that if *A* dominates *a*, *b* dominates *B*, *c* dominates *C*.

But if this hybrid (F_1) is allowed to fertilize itself, its direct descendants, *i. e.*, the second generation (F_2), show that the character or characters which had disappeared reappear in a proportion which can be predicted with almost mathematical certainty. I can not take the time to explain to you the details of this phenomenon. But the most astonishing thing is that among the descendants of the second generation (F_2) (that is, the descendants of the hybrid by self-fertilization) there are (1) those resembling the father exclusively (*X*), or the mother (*Y*); (2) new forms, *i. e.*, those in which a part of the paternal and maternal characters are combined in a new mosaic.

To choose a very simple example, if the two parents differed by their two pairs of characters *A B* and *a b*, the hybrid of the first generation (F_1) would bear the apparent characters *A B* or *a b*, that is, it would resemble the father or the mother exclusively, according to the predominance; that of the generation (F_2) would comprise individuals of different sorts: *AB, Ab, Ba, ab*. The two combinations *Ab* and *Ba* are new.

If, in a second case, the antagonistic gens are *ABC* for (*X*) and *a b c* for (*Y*), the first generation might be *A B C*, but in the second

we should have a larger number of categories of types; now, of these types there would be eight categories which would be constant. These would be *A B C, A B c, A b C, a B C, A b c, a B c, a b C, abc;* two of these types repeat the primitive parents, the others are new. If these latter are not allowed to fertilize each other or to be ferilized by other forms, but are self-fertilized, they will be constant in their descendance, which will behave like a new stable species.

From this we see that the mosaics of gens, which constitute the hereditary capital of species and varieties, are dissociable and that the gens, in the phenomena preceding or accompanying fecundation, execute a sort of chassé-croisé, the final result of which is determined by the laws of probability.

The number of types and new forms increases rapidly with the number of antagonistic characters. For 2 antagonistic gens there will be 4 types; for 3 gens, 8 types; for 4 gens, 16 types; for 5 gens, 32 types; for 6 gens, 64 types; for 7 gens, 128 types—and these types are constant from the second generation (in which they appeared) on.

Here we have infinite perspectives which appear on our new scientific horizon.

But to obtain these remarkable results with the desired mathematical certainty we must start with biological unity, with a pure line, with a single grain of wheat, the parent of a whole line similar to it.

From this we see the importance of Aaronsohn's discovery; it will allow us to do methodically in a few years all that 6,000 years of cultivation and unconscious selection have gained for us and perhaps also to combine and associate characters which escaped the intuitive observations of primitive peoples.

For example, we can associate the hardiness of the wild wheat with the vigor of growth of a cultivated wheat, the rust resistance of a wild variety with the seed quality of a cultivated variety, etc.[3]

But wheat is not for agriculture, wheat is to make bread. This making of bread is almost as old as the cultivation of wheat, and yet the conditions of fermentation necessary to raise the dough under the influence of leaven are still insufficiently known. We know that in this sour dough, the natural leaven, there are lactic bacteria which secrete an acid and give off a gas as well as alcohol. By means of this fermentation the dough, permeated by the gas which raises it, gives a lighter, more digestible bread. We are far from knowing all of the details of the process of bread fermentation. However that may be, for ages beer yeast has been introduced into the leaven, or, as in the time of the Romans, the "must of fermenting wine." These yeasts

[3] Bateson, "Mendelism," Cambridge, 1909. See "Mendelism," Punnet, R. C., ed. 7, Cambridge, 1909, p. 58.

are minute fungi invisible to the naked eye which attack the sugar of the bread and transform it into carbonic-acid gas and alcohol. The course of this fermentation is controlled by the presence of lactic bacteria which prevent the growth of putrefactive organisms. But here again there are lactic bacteria and lactic bacteria, yeasts and yeasts. These yeasts are again populations, mixtures of different races from which the microbiologist can select pure lines. Here Vilmorin's method must be used, *i. e.*, filiation from a single isolated germ. Thanks to this process, Hansen and others have selected a large number of strains of yeasts, each with its particular character. For science of to-day beer yeast no longer exists, but in its place there are many distinct and constant species just as there are many distinct and constant species of lactic bacteria. The problem of the future will be, then, to regulate bread fermentation by means of these selected microorganisms.

But certain flours do not rise well. Suitable ferments must be found for them. Others, like maize flour, do not rise at all. It is therefore impossible to make bread from maize alone. In 1900, at the time of the World's Exposition at Paris, I was asked this question: "How can we find a ferment to raise dough made from maize?" No yeast tried up to that time had been able to accomplish this. I then thought of using ferment from India which I had procured through Colonel Prain, director of the Kew Botanic Garden. In applying these selection methods the late Mr. A. Netchich and I obtained from these ferments, which are employed in Sikkim and the Khasia Mountains for the alcoholic fermentation of rice and Eleusine, a leaven, which alone or associated with other yeast causes maize dough to rise and thus allows bread to be made from it. We dedicated this species to Dr. Prain (*Amylomyces Prainii* = *Mucor Prainii*). I take this opportunity of announcing this discovery and putting it in reach of all those who wish to profit by it.

THE INHERITANCE OF ACQUIRED CHARACTERS

By LELAND GRIGGS, Ph.D.
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THE variability of animal bodies is a very evident fact. The individuals of every species show variety in color, form and size. Three types of variability have been discovered; fluctuating variation obeying the laws of chance, mutation appearing as sudden loss or gain of a color or other feature, and acquired characters gained by an individual in relation to its surroundings. Among these three types are sought the great factors of evolution. It is a singular fact that no great biologist has attempted to use all three of these factors as the basis of his system, but each author has sought to build his hypothesis upon some one all-important factor.

Fluctuating variation is undoubtedly the greatest of these factors in the part it has played in the history of evolution. It was made by Darwin the corner-stone of his theory when he claimed that natural and artificial selection could produce almost unlimited effects by the elimination of all but the most favorable among thousands of variants in a species. In the debates over the general theory of evolution there has been no argument more often used than the plausibility of Darwin's theory of the survival of the fittest. The public, in accepting the truth of the theory of descent, has come to look upon this factor of fluctuating variation as a necessary part of evolution. In fact, to many professional biologists Darwinism has become synonymous with the survival of the fittest variations.

The theory of mutation is the most serious opponent of the Darwinian theory of selection of variations. Based at first on the evidence gathered by De Vries, it has grown in popularity with the growth of the knowledge of the inheritance of unit characters, and with the discovery of pure line inheritance. In the minds of many biologists it has the advantage of showing a method of rapid evolution more or less independent of the guidance of natural selection. The more ardent supporters of the theory have claimed for it the position formerly held by the theory of fluctuating variations, trying to show that all evolution must be in the nature of loss or gain of unit characters.

That the familiar acquired characters of animals should be inherited was once taken for granted, and, in fact, is still a general belief in the world at large. This theory was held by Lamarck to be a great law of evolution. It was defended by Spencer, and assumed occasionally even

by Darwin. In the light of careful experiment, however, it has been largely discredited. The verdict of "not proven" has been pronounced against it, and many biologists would go even further and claim with T. H. Morgan that the theory was "unnecessary." Yet, not content with such a verdict, a small number of workers have persisted in their attempts to establish the theory of acquired characters as one of the essential factors of evolution.

Recently the discussions of evolution have begun to take a new turn. The old attempt to find one single all-important factor is being abandoned for a broader point of view that allows the possibility of many factors, some of them perhaps still unknown. V. L. Kellogg has pointed out the smallness of the number of observed mutations on which to base a comprehensive theory. Castle, a strong believer in mutation and unit characters, has affirmed his belief in the efficacy of selection in the production of new forms. Nowhere in the literature of the last year or two can be found any very dogmatic claim for a single all-important factor which will serve as the basis for all kinds of evolution.

In this new atmosphere Lamarck's theory again receives serious attention, but not in its old form. To-day no one ventures to cite such examples as Spencer's famous illustration of the puppy that inherited from its mother the trick of begging for food. Such experiments as breeding away the wings of flies in small tubes, or breeding away the eyes of flies in dark chambers, attract but little attention. No great biologist is giving much time to experiments testing the inheritance of mutilations. On the other hand, there are many experiments to test the inherited effect of starvation, to test the effect of the application of chemicals directly to the germ plasm, and to test the effect of the application of extremes of temperature to animals with ripe germ cells. Several investigators have shrewdly seen the value of working with plastic types of animals like the amphibians, which present striking examples of dimorphism such as are found in axolotyl, *Diemyctylus* and various frog tadpoles. In this field a prominent worker is Kammerer, a representative of a school of experimental evolution in Vienna.

A short summary will be given of his researches on toads, tree frogs and salamanders. A few selected experiments will show very well the nature of the most recent work on the inheritance of acquired characters.

Kammerer in his work on the toad, *Alytes,* tried to prolong the tadpole stage until sexual maturity. He exposed the young tadpoles to a number of conditions such as darkness, cold, perfectly still water, each of which acting by itself tended to prolong the larval period. By exposing tadpoles to all of these conditions acting at the same time, he succeeded in producing one sexually mature female with the usual form of a tadpole but with mouth, legs and sexual organs of an adult toad. This one example was mated to a normal male. The progeny

at the time the report was made, while not yet sexually mature, had been living in normal surroundings for six months longer than the usual larval period. Evidently the prolongation of the larval period had an inherited effect, and the new character was apparently a dominant factor. Strangely enough no inherited effect was seen in the offspring of those tadpoles which left the water before sexual maturity. Evidently the stimulus, whatever it may be, must act on the mature germ cells to produce an effect.

Other experiments were tried on this same toad with the object of changing its peculiar instinct of caring for its young. The male, under normal conditions, plants the fertilized eggs on his back and carries them there until the embryos have reached a stage just prior to the appearance of the fore-limb buds. The tadpoles are then liberated in the water. This peculiar instinct was found to be easily modified by change of surroundings.

The combined action of heat, dryness and darkness produced an egg called by Kammerer "a giant egg." The embryo from such an egg at the time of liberation was much larger than the normal type, fully twice as large, with well-developed hind limbs. Upon leaving the water the larva produced a small adult, a change in size due apparently to lack of water in the tissues. The new form of adult laid fewer eggs, which were larger and richer in yolk. Such eggs under normal conditions produced tadpoles which, in size and form at the time of hatching, were about half way between the old type and the derived type. The new character, then, was partly inherited. The stimulus in this case clearly did not act directly on the mature germ cells, but, if the dwarf form of the adult was due to lack of water in the tissues, there may have been an indirect action on the germ cells. The effect of keeping the eggs enclosed in their envelopes on moist earth for a considerable period of time produced a type of larva called by Kammerer "a land larva." This new type when placed in the water in its usual environment appeared superficially like a water larva of the same age, but a closer examination showed that the new conditions of development on land had accelerated the growth of the lungs. The land larva had lungs with well-developed air cells, while the water larva had simple sac-like lungs. The inheritance of the newly acquired character was evident, in that the embryos of the second generation could be kept on land for a much longer period before they began to show any ill effects from their unusual environment. Thus there was, according to the author, a progressive adaptation to land life through the inherited effects of environment.

In the presence of a relatively high temperature, the mature toads were constantly in and about the water, and in the breeding season mated in the water. The egg envelopes at once swelled up, and it was

impossible for the male to plant these "water eggs," as the author calls them, on its back. Therefore the early stages developed in the water as is the case with other amphibians. The habit of mating in the water became fixed, and persisted after the removal of the artificial conditions of temperature. The eggs, meantime, at each successive laying became smaller and smaller through the loss of yolk. The larvæ hatched at a much younger stage than the larvæ from normal eggs. The adults reared from the water eggs mated in the water at the first breeding season, even under normal conditions of temperature. Succeeding generations showed intensification of the new characters in the decrease of yolk, and also in the development of more gills, which changed in number from one pair to three pairs. There was, therefore, as in the preceding case, an apparently progressive adaptation to environment through the inheritance of acquired characters.

The effect of this change on the germ plasm was tested by a cross between the old type and the derived type. The new character, as judged by the instinct for mating in the water, behaved like a dominant Mendelian factor. Dominance, however, was of an unusual kind. The male, whether of the old or the new form, impressed its character on all the offspring of the first generation, but the second filial generation showed the usual kind of segregation of characters in the ratio of three individuals of the dominant form to one of the recessive. Clearly the unexpected feature in the behavior of the factors in this crossing lies in the peculiarity of the sex-limited potency, not in the segregation of factors. The most interesting fact in the experiment is the attempt to prove a change in the germ plasm by the modern method of applying the test of cross breeding.

Another series of experiments was tried on the tree frog, *Hyla*. This frog lays its eggs in the water in bunches of 800–1,000, enveloped by the usual coats of gelatine. A number of frogs were kept away from the water, but were allowed to crawl about on a water plant which held small amounts of moisture in the bases of its leaves. During the mating season the frogs deposited their eggs in the moisture on the leaves, according to a habit which is common among some of the tropical representatives of the genus. The young remained in their envelopes until the gills had become enclosed, whereas the young under normal conditions begin a free swimming life before the gills appear. A new type of adult was produced marked by its small size. These dwarfs when reaching maturity laid their eggs in water after the usual manner. The new habit was not inherited. The offspring of the dwarf frogs, however, had external gills at the time of hatching, a stage half way between the old and the derived type, and, moreover, they grew into adults of a size half way between the two types. This experiment, therefore, showed results very similar to those shown by the experiment on *Alytes*.

A third series of experiments was tried on two European salamanders, *Salamandra ater* and *Salamandra maculosa*. The former is a black mountain salamander which has the peculiar habit of bringing forth its young alive, always a brood of two with lungs already functional. The embryos pass through their early development in the body of the mother, nourished by the yolk of eggs that fail to develop. *Salamandra maculosa* is a yellow-spotted salamander of the lowlands which lays its eggs in running brooks. When kept away from the water the female of the spotted salamander at first dropped her eggs on the ground directly after fertilization. Such eggs failed to develop. In the course of two years, however, this salamander gradually acquired the habit of holding the eggs in the body for several weeks. The eggs became fewer in number and larger in size until the young were brought forth alive in a condition like that of the black salamander. Females of the latter were treated in an exactly opposite way. They were kept in or near the water until they acquired the habits of the spotted salamander. Inheritance was imperfect in each case. The new type of spotted salamander, under the usual normal conditions, deposited in the water a brood of five fairly well developed young. The new type of black salamander, under normal conditions, deposited in the water a brood of three young in a stage of development more advanced than that of the spotted salamander. When the artificial conditions of the experiments were continued through two generations the effect was greater. The author claims that his experiments show the inheritance of acquired characters influencing structure and instinct.

A second experiment was tried on *Salamandra maculosa* to test the inheritance of acquired color due to change of background. A brood of young salamanders was divided into two lots, one of which was kept for six years on a background of yellow, the other on a background of black. The former showed a decided increase in yellow markings, the latter an increase in black markings. The young of the yellow type were allowed to begin their development on a background of neutral tint, but before reaching maturity the brood was divided as before into two parts and placed, one part on a yellow background, the other on a black background. The set on yellow, after two years, showed a great increase of the yellow markings as compared with their parents, in fact the yellow pigment nearly covered the body. The set on the black background showed more black than their parents, but less black than the previous set similarly treated but of normal parents. These experiments, according to the author, show the progressive effect of environment in the inheritance of acquired colors.

The evidence presented by these experiments, which have been briefly described in the preceding paragraphs, should be considered in

the light of the most recently discovered principles of heredity. A very important conception in this connection is the continuity of the germ plasm, another is the variability of the potency of unit characters.

Admitting, then, that certain acquired characters have actually appeared in later generations, we should consider, first, whether or not the germ plasm has been changed by the stimulus which has produced the changes in the body. It has been shown that starvation in the larval stages of insects will produce dwarfs in later generations, but here it is assumed that the unfavorable conditions surrounding the germ plasm persist and that there is no real change in the composition of the germ plasm. Can Kammerer's results be explained in the same way? Of course a Lamarckian can not be asked to produce a form which will not revert. The only test that can be readily applied is that of Mendelian inheritance. It has been shown by the author that in one case at least the new factor behaved like a Mendelian factor. Tower also found this true in crossing a pale potato beetle, which he derived experimentally, with a beetle of the normal color. Such a test to discover a change in the composition of the germ plasm is certainly very significant.

Granted, then, that the germ plasm has been changed, we should next consider whether it has been changed directly or indirectly. The experiment of keeping tadpoles in water for an abnormally long time showed that in order to affect the next generation the stimulus must continue to act until the sex cells are mature. Tower also came to the same conclusion in his experiments on the potato beetle where heat was the stimulus. The changes, then, are probably due to the direct action of chemical and physical stimuli on the germ plasm contained in the ripe germ cells, exactly as MacDougal produces mutations, as he claims, by injecting chemicals into the ovary of a plant. But why should the stimuli not effect the germ plasm of the embryo as well, since, according to the theory of continuity, the same plasm is always present even in the youngest stages? It may possibly be claimed that, if any such effect is produced in the embryo, the change is repaired before reproduction takes place.

Granted, then, that the germ plasm in these cases is more or less directly affected by the environment, we should consider whether the change is more than a change of potency of a factor already present. According to Castle such potency may be increased by selection. Perhaps the new environment may increase in some way the potency of a factor which is present in a weak condition. For example, in the case of the spotted salamander, the potency of the factor represented by the yellow pigment may possibly be changed by the action of the yellow light, which actually increases the amount of the pigment in the body of the adult until perhaps the nature of the fluids of the body cavity

are affected and hence the germ cells themselves. Certainly such interpretations, while the merest speculations, are hard to deny from the known facts.

In such theoretical discussions of the nature of germ plasm and the potency of factors biologists are very apt to lose sight of the true historical purpose of the hypothesis of the inheritance of acquired characters. The real question to be answered first is whether or not acquired characters actually appear in following generations to such an extent as to make real contributions to the course of evolution. Even if the so-called inheritance is really a change in potency due to the direct action of stimuli on the germ plasm, nevertheless, the Lamarckian factor may be a real factor. We have not explained away any process by showing the method of its operation. The real question to be decided should be stated broadly. Do new habits and new environment produce changes in form which are of importance in organic evolution? While a final answer can not at present be given to the question, it may safely be stated that a renewal of interest in Lamarck's factor is justified by the results of recent research.

CANST THOU NOT MINISTER TO A MIND DISEASED?

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WITH respect to this most pathetic question of the sick-room, the good Doctor in "Macbeth" seems to have exhausted the medical possibilities of his time, in his answer, "Therein the patient must minister to himself." Moreover, had he tried, though never so devotedly, to remove from Lady Macbeth's mind the "thick-coming fancies that kept her from her rest," he would have almost ignominiously failed, not only to "cure her of that," but equally to

> Pluck from memory a rooted sorrow,
> Raze out the written troubles of the brain,
> And with some sweet oblivious antidote
> Cleanse the stuff'd bosom of that perilous stuff
> Which weighs upon the heart;

and all this, in spite of the dangerous gravity of the case, and his royal employer's urgent need.

Indeed, not only then but always, even until now, has the skill requisite "to purge to sound and pristine health" the mind thus seriously troubled been so generally wanting, that it does not now seem amiss to point out once more some of the difficulties which lie in the way, and likewise to indicate wherein, to some extent at least, surer and more permanent means of success than those heretofore used may be looked for, if not just now, then in the near future.

In this worthy undertaking, even Macbeth himself, by his remarkable diagnosis, may help us to make a more promising beginning than his contemporary physician could possibly make, at that time, and without necessarily becoming involved in so many of the mistakes which otherwise might seriously obstruct vision and paralyze action as well. To the king, stunned, remorseful, apprehensive as he was, the case presented, notwithstanding, certain very definite characteristics, which, in his rather picturesque classification, may be noted as "thick-coming fancies," "rooted sorrow," "written troubles," and the "stuff'd bosom" that "weighs upon the heart." Looked at in the light of modern knowledge, this list of insistent ideation, deep grief, visual hallucinations, morbid apprehensions and fears, guilty conscience and depressed emotions, are seen to make up still a very large percentage indeed of the sufferings of those who are looked upon as having either potentially or

actually a "mind diseased," and who have imperative need to be cured, if possible.

Yet, frequent as this kind of disease is, great as is the suffering, so often prolonged indefinitely, and so often full of hindrance and atrophy and danger, it yet remains a matter of very common observation, that anything like a full understanding and appreciation of its real significance, or a desirable possession of efficient skill in its management and relief, is almost as unusual now as it was when Lady Macbeth's "amazed" physician so fumbled in his answer to Macbeth's demand, "Well, well, well. . . . This disease is beyond my practise. . . . More needs she the divine than the physician," but consoled himself so complacently by adding, with by no means unfamiliar unction, "God, God forgive us all!" and thus justified Macbeth's, "Throw physic to the dogs; I'll none of it," with an unsuspected completeness!

Nevertheless, no matter how incompetent Macbeth's physician felt himself seriously to be, one now feels, especially in the presence of actual cases, that the acknowledged darkness respecting the more common conceptions of a "mind diseased," or more definitely, "mental pain," and all its invaliding consequences should not continue indefinitely to prevail; and also, with equal warmth, that with more accurate knowledge there ought to come a better and still better practical skill in dealing with it, both by way of cure and prevention. Much promise of this there certainly now is, especially in the rapidly accumulating reports of those who have recently devoted themselves to careful investigations of the varied substrata of consciousness, through certain ingenious yet well-considered processes known as "psycho-analysis"; through careful study of the effects of fright, whether experienced during waking hours or in natural dreams, and as recited by those who remember and are competent to give them form; through studies of autohypnosis, and various induced "hypnoidal" conditions and the records of what is thus revealed; to which may be added a like study of the contents of certain waking trance-like or semi-hypnotic dreamy states; the coming and going of "tunes in the head," and all the other distressing trains of "imperative" ideas and impulses ("obsessions"); as well as, possibly, an entirely new series of results to be obtained through photographic records of changes in facial expression—*i. e.*, through accurate observation and interpretation of the "physiognomical (phiz) reflex" through all these, together with much other probable investigation along lines yet to be uncovered—all of which must before very long certainly add almost beyond calculation to our present knowledge of a "mind diseased" in itself, as well as of our means for its successful alleviation.

In connection with this, there undoubtedly appears something like an imperative duty on the part of all to help on these investigations and thus serviceably pave the way for practical application of what may thus be

gleaned as rapidly and as fully as possible; while to any one who has personally reached the point where he can carefully differentiate the essential features of the more frequent cases of a mind diseased, as these appear in different communities or families, and especially to one who has come more or less to fully appreciate some or all of its discouraging perplexities, depressions, fears and apprehensions; or its disappointments, emotional perversions and interferences; or the accompanying loss of confidence and hope, inordinate sense of dependence, seemingly irrevocable detachment from human and divine fellowship; and perhaps something of the shame and degradation, the general unfitness for planning work, and the conscious inadequacy of power to do it, incident thereto;—who has in fact rightly comprehended what goes to make up dire *mental pain,* and the inevitable "sickness of soul" that centers in and clusters about the innermost selfhood in all these distressing cases—to such an one a prompting to further study and to more skilful practise, as well as to enthusiastic hope regarding it all, becomes so irresistible that any suggestion of apology for even intrusive interest and propaganda is not to be thought of.

With respect to the manner in which this kind of suffering comes to be, it may be said that almost every unusual experience has in it one or more elements of causation of subsequent mental pain and derangement. Most certainly, even such experiences as broken bones may lead to it; likewise, post-infections as well as certain endogenous poisonings are sources not to be neglected; also, too many children, too heavy financial burdens, too prolonged hours of arduous labor, physical or mental; too overweening or unrealized ambitions; or poorly cooked food and noxious air; disappointed love or social aspiration; financial reverses and other forms of "ill-luck"; as well as unsatisfied deeply implanted longings of every sort; weak will or over-emotionalism; gluttony and laziness; early impressive childish experiences, especially terrorizing dreams, frightful shocks, prolonged perversions of development; gloomy or inadequate education; unpropitious parenthood; vicious or disturbing neighborhood—all these may contribute, in incalculable proportion, yet never except by their due share, either to the genesis of a mind painfully diseased, or to its prolongation and deepening, or worse still, in many instances, to most serious interference with cure.

Thus, by way of particularizing in respect to our present purpose, let us consider an instance where the mental pain has developed in the course of recovery from some kind of not unusual physical injury, or of ordinary infection from without.

In a certain proportion of such cases, it is to be noted, especially in the more impressionable constitutions, that long before the physical trouble or infection can be recovered from, even though most prompt and efficient measures have been resorted to, the tendency to the de-

velopment of mental pain has become so marked and the results so deeply registered, that it is with great difficulty and only after much time that it can in turn be recovered from, if ever at all. Could we ever have accurate data or skilled experience enough to enable us truly and properly to differentiate the readily impressionable and weakly resisting, from the less impressionable and fully resisting, constitution, the problem of what to expect and consequently what to do by way of prevention in these cases would be much simplified. But here as elsewhere our knowledge respecting inherited traits and tendencies is so vague that practically it is not to be relied upon, at any rate very absolutely or very generally. Hence, it follows, beyond question, that the universally better way is to secure complete recovery from every sort of physical trouble, no matter of what nature or how severe or otherwise, as quickly as possible, and likewise during all the time required for this to sedulously guard against the invasion of mental invalidism with as much determination and skill as against renewal of the injury, or against contagious diseases or other purely physical complication; and if, perchance, mental pain does appear, then promptly to apply such corrective measures as will prevent, so far as possible, its further development into a permanent after condition. Nipped thus at its inception mental disease as a concomitant and resultant of physical trauma or infection can often most surely be; and the outcome to the sufferer is of the nature of a benefit that is simply incalculable.

Important, however, as this theoretically must appear to every one, how frequently, notwithstanding, is exactly the opposite seen. During the process of recovery from physical injury, not only is there incredibly often little or no thought given to the possibility of an original simultaneous psychical "insult," or to subsequent consequences which may be owing to necessarily prolonged distress and confinement and weakening; on the contrary, how often likewise does it seem as if everything untoward was most unwittingly allowed, or made, day by day, to conspire to deepen the impressions of the original experience and whatever immediately follows, as well as to make doubly sure that what was at first but truly accidental and comparatively harmless, shall almost designedly be made to develop into something which in the end must prove to be as permanent and blasting as it was unexpected. Into this conspiracy, not only do the immediate friends and acquaintances of the sufferer often most thoughtlessly enter, but, and it is strange so frequently to note, do those higher in authority and responsibility likewise as unwittingly enter and remain, with a resulting summation of consequences to the sufferer, which in the given case simply defies anticipation or even estimation. Nor in this connection should the rather too frequent untoward outcome of ordinary operative procedures and post-operative care be thoughtlessly passed by. Sometimes, even on the

operating table, or more frequently during the period of recovery from anesthesia, or, in fact, at any time later, the sensitive mind may thus receive impressions which may persist permanently and prove to be sources of painful invaliding beyond all expectation. In fact, it is beyond question true that the real importance of psychical insult as a close fellow of physical injury, or the danger from the stresses and other conditions following, should in every case receive a much more thoughtful consideration from all those who have to do with it, than ever has been or is now the rule. We blame and punish those who do not provide against the consequences of the physical injury itself, or against the invasion and development of endangering infectious diseases. But often these, bad as they are, are of little consequence, compared with the results of inadequate or bungling care of the psychical insults, and subsequent untoward impressions and tensions, which so often accompany or follow physical conditions, whether accidental or designed. Certainly, it were better to have a pitted face or a crooked leg than to go through the remainder of life with irrecoverable mental imperfections and distresses. Better a weak back than a weak will; the loss of a member than the loss of normal ambition and hope; better physical pain with the mind free than mental pain with the body useless because of it!

Everything that may be said about prevening the anticipation and prevention of mental invalidism in conditions that are naturally but incidental to physical trauma, may be said, also, and with even greater emphasis, with respect to its connection with the beginning or course of a large number of cases of ordinary illness, including, as these usually do, noticeable weakness, certain depressing autointoxications, incidental effects of use or abuse of various drugs, and more or less prolonged and nearly absolute isolation—favoring conditions that are almost always more or less necessarily experienced. Here the laity, especially if not checked, are liable as a rule to as unhesitatingly as unwittingly convert any sick-room into a fateful "gossip-room" of such a horrifying and dangerous character, that even a well person may wisely shun it for safety if not from choice; while those in authoritative command likewise seem somewhat too frequently not to realize with anything like becoming fullness the deep and abiding injury which inexcusable thoughtlessness, as well as all manner of unwholesome speech and conduct, may so frequently lead to. More than once has life-long soul-sickness been traced to this kind of impression received during an illness, wherein the hapless victim was made to receive impressions of such a deeply searching and staying character, that forever after dire consequences have remained, to either primarily or secondarily afflict with untold and irrecoverable mental pain. Undoubtedly, it not infrequently happens, also, that certain chance speculative

remarks of physicians and nurses have altogether more to do in initiating certain painful mental and emotional currents, which afterwards develop untowardly out of all proportion to their importance, than is commonly recognized. The chance remark of a doctor once caused a really well man to go about with his hand over his supposedly diseased heart in such constant painful fear and apprehension, that he almost "went insane," and this for fourteen years, until, in fact, he was relieved by practical demonstrations that he had no such heart-crippling whatever.

Into no sick-room whatever, therefore, should any sort of lugubrious tale-bearer, conceited self-exhibitor, maudlin selfish sympathizer, or self-sufficient or careless professional *poseur* ever be admitted or allowed to remain, even when the sickness itself is of minor importance, and of inconsiderable duration, and the sufferer as yet appears to be normally minded. When ill, suggestibility is often much heightened or warped; and it frequently does not take long for the sanest invalid to become so profoundly impressed—so stung, or probed, or strained, or painfully awakened—that this may prove, because of the lessened resistance at the time, to be the source of troubles which may develop literally and last forever. Of course the danger varies greatly with different people, as well as with the kind and duration of the shock and stress suffered. Some people are naturally too "thick-skinned" to be easily or much affected by any such thing; but much more frequently than is suspected is it otherwise; so frequently, in fact, that it is by far safer always to keep the atmosphere of every sick-room, from beginning to end, so pure and bracing that the sufferer's mind, as never elsewhere, shall be quite exclusively impressed by what alone is of good report, and consequently uplifting and fortifying. As to the common practise, especially during the most susceptible period of all, that of convalescence, with a view chiefly to mental diversion, of reading or hearing read the common newspapers with all their tales of undermining horrors and wrong, or the "latest" novels which are so often but mere travesties of the higher human longings and thoughts and modes of living, scarcely too severe condemnation can be urged. One can never anticipate what untoward atavistic reminiscence may thus be called up, even in the strongest minded, or what former harmful personal experience may thus be made once again distinctively to renew its life; nor can one in either case very probably estimate the permanent vitiation of mental strength and ease which may follow. Better by far most certainly to encourage, instead, the perusal of that literature only which is at once clean, strong, inspiring and rightly awakening, and thus to get the untold benefit of such a veritable "soul-bath" as can certainly be relied upon in so doing. Indeed, there is no question that, when such simple, strong, wholesome sentiments only are thus allowed regularly each day or hour to influence

the susceptible mind, it may eventually prove to be more useful in obviating and relieving the "mind diseased," than almost any other simple measure that can be thought of.

Third, let us now consider another different yet quite as prolific source of mental pain and its resulting invalidism, namely, that which is to be found in the ever-insistent consciousness of *misfit* into the ever-growing complexity and demands of the life of to-day, the necessarily consequent failure to realize what has been legitimately expected and striven for, and all the mental wear and tear which so necessarily follows or accrues.

For instance, when a sensitive man actually finds himself buffeted about in this world, with little or no ability to get anything like a sure foothold, and can think of no definite prospect of final prosperity for his encouragement, he naturally enough wears out his will-power as well as his sense of well-being long before his time, and consequently becomes the unresisting if not fully assenting prey to every depressing and perplexing influence about him. Or, when a woman finds that all her unique wealth of natural instincts and endowments promises to be of little demand in this conventional world, and so must go from day to day to tasks from which she derives little profit and no inspiration, she also rapidly develops a mental and emotional pain and weakness—a veritable soul-sickness—so deep and abiding, often, that the wonder is that either she or so many of her sisters ever have the courage requisite to go on and achieve so successfully as they do. Of course it were easy to say that the needed refitting in many of these cases is practically impossible; or that, even ideally, it is altogether too elevated, in any case, to be within ordinary application. Of course, too, every step on the way to securing the necessary changes of attitude in the individual's mind toward the real possibilities of his unusued or wrongly used powers and toward full acceptation of suggested ideals, or toward the determined devotion that sees success from the beginning, no matter how far from the purposed end—every step of this long way may only too generally prove, not only very arduous, but quite too discouraging for weak and wavering humanity to progress therein, or to succeed in the end. Yet could everybody as well as the sufferer himself once be led to see how such inappropriate fittings and placings and consequent failures necessarily contribute to the development of mental suffering and invalidism, and especially if they could once get an informed, vivid view of the interfering, destroying character of every such experience in its bearing upon ultimate success and happiness, not alone of the individual sufferer, but of the entire community, in every vital respect, there would undoubtedly result not only a prompt but effectual uprising against the common ineptitude and neglect in this respect. That such a true vision is widely needed is confirmed by the

fact that misfit, inadequacy and failure cause so many people to suffer from an inhibition of the powers of right perspective, and to such an extent that they necessarily come, in time, if slowly yet most surely, to the point where they can not see the comparative virtue of the strength they still have, and the work they still can do, even as they think upon and especially feel upon so uncomfortably, what they originally expected of themselves in the great battle of life.

From these and many another supporting observation, easily and everywhere to be had, it is perfectly legitimate to conclude, beyond reasonable doubt, that mental pain and its resulting invalidism is quite naturally the necessary outcome of a great variety of causes, which may be contributed to, usually, by almost every influence that either bad heredity, accident, disease, wrong education, personal over-stress, or failure, or future uncertainty, may happen to afford. Besides, in many instances, we may unhesitatingly believe that these causes may be almost viciously, if never so unwittingly, supplemented by parents, children, relatives far and near, neighbors and friends, clergymen and physicians, gossips, fools and scandal-mongers, and all others who may as potently as unwittingly conspire to produce and prolong it. Moreover, we may note that there often exists constitutionally, or that there has been developed through disease or accident, certain definite phases of an imperative tendency toward an abnormal sensitiveness to every painful or unusual impression, so much so that when this comes to be actually coupled with an over-developed fear of consequences, it may most unexpectedly make the sufferer all too ready to fall in with almost every possible kind of trend toward this form of invalidism, and to gradually become most thoroughly a coward, or even quite panic-stricken, from the very first suggestion of subsequent trouble. That with such a constitution and with such a "push" from untoward influences of so many kinds, every temporary attack of mental pain, from no matter how insignificant a cause, may help the sufferer eventually to slide into the chronic state of mental disease, especially when day by day serious measures for relief are unsuccessful, is plainly beyond question. Thus, a pain in the back, not overcome by sufficiently strenuous or prolonged measures, may quite as easily become evidence of "spinal disease," as pain nearer the front may become a surety of "ovarian cyst"; or higher up, of "cancer of the stomach"; or at the back of the head, of "disease of the brain." And once let such a wrong notion become fixed in the mind, especially of both patient and attendants, as it often does, and then be reinforced by reference to it, or by any set of persistent untoward circumstances, as all too often is the case, temporary or permanent disease of mind may follow, in the natural course of events, as surely as night the day, and with scarcely ever a bright morning in prospect.

Such considerations as these, consequently, make the question as to what may be done to prevent the development of such a condition, or to successfully minister to it eventually, an altogether most serious matter, especially in cases where not only the sufferer's own conditions and tendencies, but those of the entire environment, have to be considered.

In the first place, there can be no question that every case of a mind diseased should be as carefully investigated and as thoroughly understood as possible, and this from the very beginning. No sort of off-hand, "intuitive" pseudo-diagnosis should ever be relied upon as a basis either of prevention or remedy; the "case" is always really too complex to admit of any such guess-work whatever. Yet it is owing to just such a want of adequate investigation and accurate diagnosis that many a sufferer from mental pain has not only not received needed prevention or relief from his would-be ministrant, but has adversely most ignorantly or presumptuously been given abundant time to sink deeper and more permanently into his misery—so deep, in fact, so overwhelmingly, many times, that afterwards the utmost skill can be but partially successful—every really opportune moment having thus been allowed to pass forever by! Altogether and always, mental pain is too serious and dangerous a matter ever to be thus looked upon indifferently or ignorantly, or to be foolishly and fatally experimented with by not fully prepared remedialists.

In many instances, also, it seems to be altogether too readily assumed that what are called "imaginary" forms of this affection may be similarly slighted and mismanged—in fact, trifled with—without much thought as to what may be the consequence in the end. Indeed, it seems often to be considered as evidence of some kind of superior wisdom, to pronounce the sufferings of a given case as "purely imaginary," and so not to be "encouraged" by any sort of attention whatever. As a rule, however, it may be absolutely taken for granted that sick people, including the uncounted number of but-half-sick people, and those too who are said to "imagine" their illness, do not repeatedly or persistently make complaints without reasons that, when once understood, are seen to be really good and sufficient; and that every complaint of seemingly imaginary suffering has always something very real beneath it, which should at least be accurately ascertained and properly considered, before the sufferer is either condemned or ignored. Recent investigations into the true nature of the inner life, especially as this has been unsuspectedly determined by accidental shock and stress while yet in the plasticity of its very early stages, have thrown much light upon many of these perplexing types of mental invalidism in older people; and it is more than probable that further scientifically directed research will make still clearer much that is now so obscure and inexplicable. Hence, it must legitimately follow that every sort of shallow conception

of mental pain will in time give way to conceptions that will be much more nearly correct, as they will be less cruel and dangerous.

However this may be, one need not hesitate to affirm to-day that we already know enough to make it absolutely unjustifiable in any case to make a "snap" diagnosis in favor of some "imaginary" disease which may be ignored or crudely managed, as ignorance, or whim, or presumption may dictate. If it be criminal to misinterpret or neglect physical ailments, it certainly is no less so thus to seriously neglect or bungle the more delicate matters of the diseased mind.

At the outset, then, every sufferer from mental distress has one inalienable right as well as the greatest need, namely, that his trouble shall be thoroughly understood, and that this understanding shall be based upon adequate investigation of *all the facts* involved in its origin and development. This, for one very important thing, will reveal unmistakably that every one of these poor sufferers from dire inadequacy, apprehension or discouragement, and from slowing and shallowing of faculties, and glooming of every outlook, are really experiencing a kind of suffering whose original and persisting causes are not less real than are those of physical suffering, although such causes may often, if not always, lie altogether too deep in the personality to be either self-discovered, or "intuitively divined," or superficially or too promptly judged. Again it will soon appear, even not less convincingly, that if such sufferers presume to rely upon self-investigation or self-treatment alone, or upon the offers of even the shrewdest ignoramus or most devoted "curest," they will most likely find themselves from the first but painfully misled and thwarted at every step, and eventually becoming more and more deeply sickened and more thoroughly discouraged than ever. It must be remembered that this kind of pain, the pain of mental disease, is always so indissolubly a part of the innermost self and bound up with its every impulse and movement; is withal so unexpectable and incalculable, so dominant and threatening, so undermining and degrading, and positively intrusive; in fact, so devilish and selfishly excluding; so monopolizing in all its tendencies and demands, that the sufferer must necessarily find himself, no matter how skilful in even his most resolute attempts at self-relief, much more frequently in the position of one who would lift himself by tugging at his boot-straps, than otherwise, and eventually not thus to be especially helped, no matter how much he tries; while as to the outcome of the hit-or-miss remedies and practises of every sort of unqualified remedialist, whether "regular" or otherwise, to which the discouraged invalid so often goes, it must be said that ultimate failure applies equally often, and with even more force. Practically speaking, it quite regularly occurs in these cases that there develops eventually the firm, almost immovable conviction of the futility of everything which might other-

wise promise relief—a conviction that correspondingly adds to the peculiar kind of dejection and endangering, which, in turn, develops into a chronicity that may evade every attempt at remedy, later on.

From what we have discovered as to the origin and development and character of mental invalidism, then, it must again be readily recognized that it does not help this sort of individual much, if any better, simply or most elaborately to have said to him, even by the best qualified, "Oh, brace up; be a man!" or anything else of like sententious order; except, perhaps, as a "starter," when it is often undoubtedly invaluable, as is also the temporary good influence of many another similar command, or prayer, or treatment. In respect of this acknowledged initial good, however, it must always be remembered that the sufferer from a mind diseased does not, can not, thrive for very long on any sort of "starter" alone, even when it is given with best intention and high emphasis, and by those otherwise skillful; indeed, it frequently appears that the very effort to "brace up" or otherwise yield to the dominating spirit serves not to secure anything like the promised relief, but simply more firmly than ever to glue attention to the insistent distress, and to contribute immeasurably to its vividness and persistency. Nor does the heartiest promise of "better times" in the future often do much more; for in such cases the sufferer himself sees altogether too clearly how near to pretense or fabrication such a promise probably is, to be able even deceptively to draw comfort or strength or other kind of remedy from it. The fact is, this species of even most authoritative remedial platitudes do not so often touch the real "spot" as is supposed; and usually for the simple reason that the real "spot" is not even suspected by either the remedialist or the sufferer; while the reaction from ever so shrewd remedial adventuring, when it seems to promise the impossible or proves to be fallacious in the end, almost always contributes to a measurable increase of the original distress, or else to the development of some new form—"the slings and arrows of outrageous fortune" having been thus but refurbished and resharpened, rather than effectually blunted and broken, by the insufficiency of remedies and promises, which, being not properly supplemented by others appropriate to the subsequent needs, soon lose even their initial value.

Practically, it is also found in many cases, that it is just a similar kind of wrong management on the part of even those who have heretofore been the most intelligently and skillfully concerned, which has led sufferers from mental invalidism to respond so very frequently, and often so very satisfyingly to themselves, for a time, at any rate, to the offerings and importunities of "irregular" practitioners, and of irregular sects of almost every description. The "mind diseased," not getting expected, and perhaps promised, light through "instruments of pre-

cision," and not getting much-needed relief from remedies directed even legitimately to organs and functions of the body alone, often grasps naturally enough at shrewdly proffered "cures" or "healings" which promise satisfaction beyond doubt from no matter what irresponsible source, and with an avidity which, if "foolish," is certainly excusable, if nothing more. Nor can anything else be expected when such a sufferer so painfully remembers that in his great and anxious need he has been time after time to a "regular" physician, only to have the real significance of his mental distress misapprehended, or to have it characterized as "silly," or "imaginary," or "not for me," or of "no consequence whatever," or, as was the case with Lady Macbeth's physician, to hear him affirm that therein the sufferer "must cure herself"; or, perhaps worse still, to be treated by heartless "bluff," placebos, or possibly by hints of a normal defection that needs a priest rather than a physician! Nor, again, can anything better be expected, when possibly in obedience to this same distracting hint, such a sufferer has sought his church, only, as it has seemed to him, to be fed with stones, to be treated with indifference, or to be poisoned with doubts and insincerity, to say nothing of the chill that so naturally comes from sham brotherliness, untrustworthy sisterliness, and all the pain that these mean to the hungry distressed soul. If in such a case the "unorthodox" either in medicine or religion can "make good" where the "orthodox" fails, let there not be unseemly surprise, or charges of foolishness or worse, against those who in spite of such neglect and misunderstanding actually do need relief and must seek relief, even until they find it. Instead, let there prevail everywhere the full measure of righteous humility which is so often really due in the premises. The great "irregular" of all time, it must be remembered, was Jesus of Nazareth; and it was He who is said to have healed the people up and down the whole land, in spite of the "regular" doctors, medical and ecclesiastical, of the time. Of course, this is no tribute to quackery as such, either within or without the "professions"; it simply teaches that any one who would really do right in this important field must by every possible endowment and preparation be first and fully possessed, not only of the proper spirit, the needed sympathy, the untiring determination to understand the actual need and provide the real remedy, but additionally, of the most perfect knowledge of human nature and all its woes that can be obtained by patient, skillful investigation, and by most rational induction from well-authenticated facts. Mere one-sided, incompetent, or vain "irregularity" does not by itself suffice, any more than mere self-sufficient or negligent "regularity." In either case, the deeper the insight, the wider the comprehension, the truer the knowledge, the more direct the skill, the better the results achieved.

When the rightly endowed, fully prepared ministrant to a mind

diseased has once been given a case of mental suffering in hand—one whose investigations have led him as accurately as possible to differentiate it from the truly alienated cases that can only be cared for in protective institutions—he is at once often confronted with conditions that tax his insight perseverance and skill, not only to an almost unwonted degree, but far beyond the comprehension and consequently the sympathy of his employers. Frequently, also, he has to contend with varied and numerous and unexpected misleadings and coverings up of facts which may be mostly owing to a previous false diagnosis; or, he finds the patient's normal ideation more or less in a state of irrecoverable atrophy or decay; or, that there is perverted emotionalism quite beyond understanding and of a continuously disastrous nature; or that the will power has been so frequently strained and wrongly directed that it can be relied upon for scarcely any good effort at all; or, so frequently, all these in most perplexing combination. In fact, the case is always one where the whole organism is more or less under the spell of the mental distress, and consequently has a minimum of recuperative forces at command. Even almost every physical function is apt to be so lowered and perverted that, in turn, they may contribute to the disease of mind and to the resistance to be overcome. In fact, the case is one of "sickness all through"; and the remedy and management must be based upon this comprehensive vision, or failure will almost inevitably result.

Hence the wise remedialist will never neglect to at once institute *every* sort of hygienic, sanitary and therapeutic measure, which may be rationally indicated. Failure here is folly unmitigated; and no assumed "special" or "exceptional" ability that presumes to get along without due attention to the physical as well as mental functioning can make it otherwise, try and promise as one may.

Having first, then, given due consideration to the conditions and needs of the *entire case,* the wise ministrant to the mind diseased will next, and at once, seek to understand in detail the changes from the normal psychology which are the immediate sources of the distress. Here, again, ability to *investigate* with a penetration and thoroughness that only the trained scientist can comprehend is the next great duty which he owes both to his patient and to himself. To accomplish this, he will bring all that his life, his reading, his special training and experience have taught him; will exercise all the mental and moral qualities of which he is possessed; will devote himself in every manner practicable, not only to relieving the present distress, but to arousing such latent and stifled mental functions as will in due season contribute of themselves to help to overcome that which is abnormal, and substitute normal thoughts and feelings in its stead. In all this he will need and should have the full confidence and intelligent help of those who are

related to or responsible for the one afflicted. On the contrary, every attempt on the part of these latter to assume or restrict his proper functions, or to cover up that which should be told, or to interpose with their own cross purposes and perverting schemes, will only serve to embarrass him, and to hinder his patient's recovery. This needs to be said everywhere and repeatedly; for it has not even yet come to pass that such a necessary harmony of opinion and action is always to be relied upon. In general, it should always be remembered that the problem presented by instances of a mind diseased is really so complex, and often so unresolvable at best, that the intuitions, the careful watching, the knowledge and the devoted skill of every one concerned, are none too much for obtaining the best possible results.

With respect to all the "newer" and promisingly better *methods* of management of a mind diseased, with respect to its own especial needs—those that have been devised by more recent investigators—it may be said, in a word, that they all seek to be based upon strictly scientific methods, and so to become more and more reliable and eventually trustworthy to an extent heretofore unknown. The first thing one notes is that it seems settled beyond question that in all these cases there shall be secured at once a most complete and searching, yet of course judicious, "scientific confession," or more properly scientific riddance through confession, of all the deeply hidden harmful feelings, thoughts and habits, that so often are really the basis of the painful mental superstructure which has supervened. In almost all this class of sufferers some such kind of revealing of the underlying sinful, or shocking, or stressful life, is found to be the best method of preparing the way for the subsequent, constructive measures which may then seem necessary. Hence, for this purpose, much attention is now given, for instance, to invoking the recollection of all the startling and harassing dreams which so often give darkness and pain to the easily impressed mind, and then to their true interpretation as affecting the waking life. Likewise, even though it be through hypnotic and allied means, it is often sought thoroughly to recall and expunge from the uttermost depths of being any and every other sort of earlier experience, whether these may have been sinful, accidentally shocking, or freighted with some kind of awful stress, in order that the sufferer shall no longer remain the unconscious victim of these "subliminal," most vicious enemies, as sorely as before. In fact, the "new method" implies that most of these cases have, to begin with, profound need of what may well be termed a "drastic psychical catharsis"; and considerable experience shows that, once having secured this, such people are, at least for the time being, very apt to be relieved from their pain, begin to be noticeably ambitious and vigorous, beget new hopes and enter-

prises, and otherwise to astonish both their friends and themselves with unexpectedly rapid, at least temporary, improvement.

But it must always be remembered that even the most intelligent use of even this most scientific initiatory method does not often serve other than as a very serviceable prerequisite to imperatively needed subsequent measures, whose main object should be, not only as thoroughly to fill the vacancy thus made by evulsion of the destructive evil as possible, but also to put something more constructive and permanent in its place. Closely investigated, the human mental activities seem largely to be built upon a system of self-mimicries ("auto-mimesis"), which fact may often be very wisely taken advantage of in dealing with its abnormalities, especially of the curable order. If through some untoward experience or constitutional "predisposition," a painful and dangerous "copy" has some time been deeply set in the mind, and subsequently this has got into the vicious habit of being reproduced in endless repetition, and so beyond self-correction, not only has this important fact a most imperative need to be duly noted, and considered, and acted upon, from first to last, but also has the equally important fact, that almost every remediable instance of a mind diseased actually has this peculiarity, and attention to this may often reveal the right clue as to what will eventually do the most good and do it most promptly and permanently.

Remembering these facts, then, it is soon found that in very many cases indeed the most practical thing to do, after the preliminary mental cleansing has been effected, is at once almost obtrusively to proceed to introduce into the sufferer's mind a greater or less number of most definite, clear, interest-laden, moving, and if possible unusual ideas, which, being by the sufferer supposed to emanate from the mind of some one whom he looks upon as more of an authority than he is capable of being by and for himself, will be allowed to make their way unhindered, so deeply as to become an efficient counter-effecting force, and thus bring about the thoroughly neutralizing and substitutive effect required. In this way, a new copy, which is at once characterized, both by fresh interest and constructive imagery, may be so powerfully and timely, and likewise so aptly, repeated, that duly the mind will almost unconsciously begin to imitate this instead of the old copy, and thus in time will become both successfully refurnished and reinvigorated, and consequently relieved, as well. Undoubtedly such a course, especially if unremittingly enlarged upon and enriched by all such determined, luxurious effort on the part of the sufferers themselves, as will perpetuate the original effect, even until such time as their dried-up mental soil shall be made once more to teem as it should with spring-like rejuvenescence of every old activity, as well as with the germination and growth of as many new interests as possible—undoubtedly such a course

will succeed where many another may fail. In this there will often be surprisingly exemplified the fact that it is the inner, emotional and intellectual life, rather than the outer physical life, which pulls men and women down, as well as keeps them up; and that in connection with a decided change in the character and direction of these there may always be expected, whenever possible, a corresponding constructive response to whatever change in environmental conditions may be considered useful, in addition.

Having thus made a right beginning and got well on the road to practical success, it is simply wonderful what a capable, intelligent, wholesome "minister to a mind diseased" can thus do, for many of these cases, where there is such a malign and persisting interference with the life of all the affective as well as effective faculties of the sick-soul, as is here to be found. Like the gentle dew from heaven is his mere coming and presence often; often, too, like a strong tower of defense and offense, is the "presence" he leaves behind; like a veritable "new birth," does it soon amount to; like a complete regeneration in the end, in many instances.

Of course, it might be naturally supposed that the first and surest step toward securing recovery, especially from the woes peculiar to the misfit, would be simply to get them out of their inappropriate environment and wrong calling into a place and work more suitable for their endowment and preparation. And so it would be and is, in a comparatively few or perhaps many cases. But with the rest it is almost universally the fact that for so long a time have they been bred and trained in the midst of unrealization and unsatisfaction and consequently of rebellion and despair, and not less important in the direction of atrophy and negation of powers, that even when their outward circumstances have once been most wisely mended they do not respond nearly so constructively as might naturally be expected. Mostly, such people need a change of life within before they can satisfactorily appreciate and constructively respond to a change of life without. Until this change is accomplished—until the intellect and emotions and expectancies have been given at least a new direction—outer changes are much more likely, particularly in adults, to result in some or all of the unexpected disappointments which every other kind of unwise experimentation is everywhere so apt to see.

Having, then, as thoroughly cleared the sufferer's mind of every affecting and destructive idea and feeling as possible, and skillfully filled it with certain other ideas and feelings, which should be selected entirely for their own constructive, curative and inspiring qualities, it follows with equal necessity that the good work should not stop here, by any means, but rather should be supplemented unremittingly by most persistent use of every such well-selected, strong, wholesome, com-

prehensive measure, such as change of environment, work, study, reading, etc., as will naturally effect, step by step, the completion and fixity of the mental and emotional reorganization so obviously needed. For, no matter how effective the initial catharsis and substitution may be, if the remedialist does not know enough or has not spirit enough to follow up this concededly important ministry by subsequent adaptive effort, persisted in until the end is attained, his labor will be mostly in vain. Here it is, undoubtedly, that so many of the "practitioners" of the various systems of "transcendental medicine," pseudo-science, rampant humbuggery, "queer" theology, and vicious imposition generally, are not able to secure the permanent results predicted of them from their temporary success. Many of these can give and often do give a good enough start toward relief to warrant the confidence which such a course engenders; but they break down entirely as soon as anything additional is required, and so, either lose their influence at once, or else are forced, by maintaining a series of illusions which in time fatefully show themselves to be such, to continue to doggedly sustain some other sort of equally temporary measure, if not base imposition, which deservedly brings its dire reward upon their heads in the end. In these cases a single measure or practise of any kind, no matter how good or true, when persistently inculcated or exercised without timely and appropriate variation or addition, soon comes to the end of its chief usefulness; for the nature of the human mental and nervous organization predetermines that atrophy and decay in the realm of feeling and willing just as surely follow closely upon the over-exercise which produces an initial hypertrophy, as it does similarly in the physical realm. But the ignorant or indifferent practitioner does not consider this; and so pushes on unvaryingly with his initiatory measures only, or with others of similar or greater misleading import, and consequently finds that the original condition of his patient often comes to have duly added thereto, certain other abnormalities, which, although newly acquired, may yet prove to be not less distressing or less persistent than the original ones. So trite an injunction, then, as "Overcome evil with good" when applied to the needs of a mind diseased, is thus seen to necessitate a *right kind of persistent overcoming,* wherein the void repeatedly secured by eliminating the evil is continuously filled with restorative "good," the strength gained from time to time is constructively exercised, and all the psychic pathological conditions are thus led or made to give way eventually to normal states and activities.

Perhaps this is quite sufficient to enable us to conclude, finally, that permanent satisfactory results in this important field of remedial ministry can seldom be secured, unless due attention be given, first, to getting at the real sources of the sufferer's breakdown; second, to correcting, contributing and hindering physical diseases; third, to purging

offending mental imagery, and eliminating the deeper origins of pathological fears and distrusts and consequent exhaustion and pain; fourth, to making, and from time to time, remaking, as profoundly constructive impressions as possible; and, fifth, to reeducating and repractising every mental and emotional factor in such a sure way that eventually comprehensive reorganization is permanently effected, and the deeper, truer self is made to regain its normal attitude towards the world in which it finds itself, as well as the strength and habitual new activities which will enable it to maintain itself against subsequent insult and stress—in fact until the mind is once more as full of *ease,* as it was at the beginning full of *dis*-ease.

THE POSITION OF WOMEN IN CHINA

By Dr. L. PEARL BOGGS

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SOME sage has said "A nation stands as high as its women." In making up an estimate of China at a time when she is earnestly desiring recognition as a republic, it may not be out of place to consider the position of women with a view to judging the chances which the new government has for stability.

Every one is familiar with the story and the personality of the late Empress Dowager, who, for nearly half a century, swayed the destiny of China's 400,000,000 people at perhaps the most critical times in their country's history. It was during the first years of her regency that the formidable Taiping rebellion was finally put down, thus insuring the integrity of the empire from within. It was also during her term of power that China suffered many humiliating experiences at the hands of foreign countries, including Japan, but nevertheless China as an empire was left practically intact. During her last term of regency, the government committed itself to modern western education and to constitutional government. It was a powerful personality that could hold the empire to the old way when a vigorous young party was striving to uproot old customs and law, and in turn could bring the old conservative party to heel when the change to new ways was finally determined upon. This could not have happened where women have no rights, honor or privileges.

What the empress did in her exalted station, any strong woman can do in whatever station she may be born. We hear, therefore, of women occasionally becoming the head of a family or clan, for something of the old-style patriarchal family is the prevalent form in China and is composed of grandparents, married sons and their families, and perhaps also younger brothers or cousins. The three submissions of which one hears so much in the orient, means that a woman must submit to the authority of the head of the family, be he her father, husband or son. A woman does not usually become the head of a family unless she is the widow of the former head and she rises to this position only if she is the strongest personality by far in the group. The writer does happen to know a forceful young Chinese woman who is known all over the country side as "the Christian girl who runs a farm alone and is the head of a family." Before her, the grandmother had been the ruler of the clan and had been honored by the erection of a "pailow," or three stone arches, by order of the emperor.

But in the main it is due to her position as the mother and grandmother of sons that she is honored, and every Chinese woman prays

for the gift of male offspring as Hannah of old must have prayed for Samuel. In reading the legends, biographies and anecdotes of Chinese life, one is struck with the respect paid to the mother as well as with the love rendered her by her children. In the works of the two great sages, Confucius and Mencius, love, reverence and obedience are enjoined as the due of both parents. The funeral rights of both parents are to be duly celebrated, and the ancestral tablet of the mother is always placed by that of the father and reverence is given to both.

In the history of China we read of several great empresses and empress dowagers who added to the luster of the renowned people of Han. In the ancient Book of Poetry, which is one of the great classics of the world, many women are celebrated in song for their piety and virtue, their wifely devotion, or motherly tenderness. There is a book of memoirs of distinguished women written about 125 B.C. and I know of no other book in any language at that time dealing with the greatness and goodness of women. Likewise the first book on the education of women is said to have been written in this language about two centuries later by a celebrated poetess and historian, Pan Chao, who for her learning and piety was appointed preceptress of the empress and honored by the emperor with the title of the Great Lady Tsao. Thus we see that in olden times the women of this country held a relatively high position, perhaps as high as the women in any pre-Christian civilization ever held.

But there is a somewhat darker side to be shown, when we come to speak of the modern Chinese woman as other than a mother. The childless wife of a rich man, or one who has borne him no sons, lives in fear lest he will take other wives. The presence of secondary wives, for according to law it is impossible for a man to have more than one legal wife, does not make for harmony in the household, especially if they succeed in alienating the affections of the husband. Divorce of the first wife is almost unheard of, and as the greatest crime a man can commit is to bear no sons, the practise of polygamy is defended on the highest ethical and religious grounds. The secondary wife is said to have no legal standing, but her children are considered just as legitimate as those of the first wife, to whom indeed they are said to belong. We have to picture to ourselves conditions somewhat as shown in the Biblical story of the patriarch Jacob and his wives and their handmaidens.

If the lot of the first wife is not always enviable, one can imagine that the concubines are not exactly happy. They are expected to be obedient to the headwife who rules the inner apartments, or women's quarters. In some cases they are little more than high-class servants and are often drawn from a class of society lower than the husband. Sometimes they are secured at brothels where they have captured the fancy of a rich man by their beauty and accomplishments. In some

families, however, the wives are said to live in happiness and harmony, and it has been the writer's privilege to know a Chinese Christian lady who showed the greatest kindness to the wives whom her Confucian husband had brought home, although his conduct had almost broken her heart.

On the whole, Chinese women are raising their voices against polygamy, as are the modern educated young men. It is difficult to see how a radical change can be effected very rapidly without entailing great suffering on helpless women, for the organization of a government may be changed quickly, but not that of domestic life. With the greater education of women which will make them to a certain extent economically independent, and with the example of western life, which every year is making more impression on the people, we may confidently expect the ultimate decision of this oriental people will be in favor of monogamy. It is needless to say that Christianity will teach this, as the missionaries are committed to an uncompromising opposition to all secondary marriages.

As everywhere, perhaps, the great middle class are the happiest in their domestic relations. The husband is too poor to buy other wives and maintain them, so that a male child is often adopted, from the clan if possible, to carry on the ancestor worship and perpetuate the name. The wife among the very poor may be sold as a slave and the money taken to buy another wife. If left a widow without grown sons, she may be sold as a wife again by her husband's relatives before the grass has grown green on his grave. Nowadays, there is a law to prevent a woman's being sold against her will, but often among the poor there is no alternative.

But the burden of all China's poverty seems to me to rest most heavily on the young girl. As an infant, if there are too many mouths to feed, her life is snuffed out in its first hours. In times of poverty and stress of famine, the first resort is to sell the little girls. If not as a wife, then as a slave or concubine. It does not require much imagination to picture what a little slave girl may suffer if her owners are unkind and she is sold about from one to another. On the other hand, she may come into a good family and occupy a useful and honorable position. There is a law that no maid slave shall be denied the right of marriage, and if she is attractive it may be to one of the men of the family. If the little girl is sold as a child wife, her lot may be very unhappy, for her mother-in-law is likely to make her the drudge of the family, and her husband, if he feels any affection, is never supposed to interfere in her behalf, as that only makes matters worse. The birth of a son is the great alleviating factor, for then a woman has performed the chief function in life.

One is not to suppose that the evils here mentioned, such as infanticide and girl slavery, denote any particular cruelty of nature on the

part of the Chinese people. Nearly all nations at some time in their history have practised infanticide, and slavery has not long been banished from our midst. The factors which have combined to keep up these practises may be traced back perhaps to the religion of the country which is that of ancestor worship. To this is due the over-population of the country in part; to this is due the marked preference for male rather than female offspring, as it is only through the former that the ancestor worship may be maintained; to this is due the early child marriages and secondary marriages, both of which tend to crush the young girl. It is knowing these facts, which impell the thinking people of Christian lands to feel the burden of sending to non-Christian countries those apostles who shall preach a religion of the spirit which knows no distinction of sex, or class, or race. To the teaching of a spiritual religion must be added the teaching of modern science and economics, for the practical mind of the Chinese can sometimes be reached by scientific laws and cold statistics where prayer and preaching fail.

The life of the daughter of the rich is not so bad, aside from the suffering of that ridiculous and antiquated practise of footbinding. So far as I know, no explanation has ever been found of this cruel custom and, besides the real suffering which the child undergoes, the individual is maimed for life and suffers not only the inconvenience of crippled feet, but also in general health from lack of exercise. In some families the daughters are given a little education in books as well as music and embroidery and, since the desire for the modern learning is spreading, it is said that every palace and official residence in Peking is filled with girls and women anxious to learn and who are studying as best they can.

It is certainly true that the educated women of China are making a name and a place for themselves and are working hard to better the condition of women as a whole. A visitor to that country to-day will find Chinese women as the heads of hospitals and in some cases also conducting nurses' training schools. They are principals of large government or private schools for girls, and many of them are doing excellent work. A few young women have graduated from American colleges, but the majority of principals and teachers are the products of mission or government schools. The very wealthy of course have private tutors and some of the most zealous women in founding schools for girls have been from princely families.

The ladies in their homes are also working for reforms and thousands signed petitions sent to England protesting against the opium trade which that country forces on China. They are forming anti-cigarette leagues and holding meetings at which some of them preside and speak with great intelligence and dignity. They are zealous in the anti-footbinding societies and take an active part in church and phil-

anthropic work if they are Christians. Nor should one forget to speak of the women in the church who go about as teachers of the Bible or on errands of mercy to the poor and suffering. Some of these are ladies of fine families and great learning, while others are poor country women, whose chief qualifications are a tender heart and a sympathetic mind rather than literary attainments.

During the late revolution the women bore no inconsiderable part. They were active in plotting and many women dedicated their fortunes and their lives to the dangerous work of propagating revolutionary doctrines or smuggling in arms from foreign countries. Young women everywhere were determined to enlist as soldiers, and in a few places "Amazon corps" were formed. Many others offered their services as nurses and the trained nurses and Bible women are said to have done effective work. Public meetings were held in all the large cities at which women spoke in behalf of the revolution, and wealthy women pledged their jewels to raise the much needed funds.

One of the most hopeful signs of all is the fact that the government promises to provide educational advantages for all girls in the same schools with the little boys until the age of ten, and afterwards by a separate system which is to end for the present in a higher normal school for girls. There seems to be a really awakened conscience on the matter of the education of women and there is something pathetic in the pleas which the educated young men of China are making that their wives and sisters may be educated. With their modern education, they are beginning to realize what it means to a man to have an uneducated woman for a wife or as the mother of their children. They are not ambitious therefore for an education which shall fit women for public positions so much as for good home makers. They realize that in China's present condition woman's greatest work lies in establishing new ideals of home life.

China has always been a moral rather than a religious nation, which means that the family rather than the individual sense has been developed. This may militate against the rapid growth of freedom for women in public life, but in the end will give her a secure and honored position. Perhaps the greatest problem in that country at present is the struggle which is on between family loyalty and individualism. It is hoped that this agitation will not so shake the moral foundations of the people that it will bring on a demoralization before it has had time to adjust itself to that broad socialism which is founded on individualism rather than is opposed to it. In the trying time that is coming, we believe that the women may hold the power to regulate the pace of the change which is inevitable. For the women of China are strongly moral, and the power of women in moral things has been recognized by the Chinese. One writer says: "Purification of morals, from the time of creation until now, has always come from woman."

THE SOCIALIZATION OF THE COLLEGE

By Professor WALTER LIBBY

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THE expression socialization of the college is here used not to indicate a process to be set going at some time in the future, but to denote a development which can be observed in the history of institutions of higher learning and which educational leaders as the conscious guides of evolution may now further, direct, and render consistent with itself. A comparison of the Oxford clerk of the fourteenth century, ascetic, other-worldly, sententious, immersed in scholastic logic, with some of the alert, yet philosophical, public men produced by the English universities of to-day, shows the line that academic evolution has followed during the intervening centuries. On this continent these contrasted types of university man find their analogies in the Harvard man of the middle of the seventeenth century, a clergyman trained by the clergy for the clergy, and the Harvard man of the twentieth century, educated under more democratic and less clerical influences.

The tendency of colleges to change in adapting themselves to changed social conditions is obvious enough. At the same time it is generally admitted that through economic and other changes society is marked by greater and greater complexity. How must we shape the college curriculum, methods, administration, etc., in order that our graduates may prove themselves efficient in the complex social conditions of the present day? This is the problem whose solution we and all interested in the progress of higher education have to discover. To the settlement of this question as it presents itself at this time I wish to offer a slight contribution from the standpoint of the college professor of pedagogy.

In the first place, for an American college to adopt at this time the narrow curriculum that two centuries ago introduced the student to professional studies would be a reversion dictated by despair. Fundamental as Latin, Greek and mathematics are to our civilization, our culture, our science, they do not of themselves afford an adequate preparation for life under modern conditions. Helpful as Latin and Greek are to our esthetic appreciation and sense of ethical values, filled with illumination and bristling with suggestions as are the ancient literatures, they could not mean so much for us had our minds not been formed and informed by other studies. Even as a step toward the dif-

ferentiation of colleges the adoption of the old curriculum would seem unwise, for the preparation needed for professional study to-day is quite other than it was in the seventeenth century.

One change entailed in the college curriculum by the growing complexity of modern social conditions is some recognition in the courses of instruction of those conditions themselves. In a democratic country we should all know how the other half lives. Social problems and needs must be learned. I wish to emphasize the truth that if they are to be known they must be taught. People who appear callous and cruel, indifferent to private needs and public welfare, are often merely uninformed. That the undergraduate years offer the opportunity for the presentation of such matter there is sufficient evidence.

During the last few years my department has taken up with the students in pedagogy the educational aspects of the university settlement, child-labor legislation, juvenile crime, the home, defectives, primitive peoples, eugenics, morals and hygiene, the immigrant, the new schools, open-air schools, etc. The work is conducted in seminar style, each student choosing a topic for intensive treatment. The response to these subjects from juniors, seniors and graduates is very cordial and very immediate. They cover, if you like, the romantic and sentimental phases of social activity, and the appeal is no less powerful on that account. On the other hand, there is no attempt on my part to suppress a discussion of the futility of some forms of philanthropy. I think the ultimate effect of such a course is to give content to the idea of good citizenship, to check latent snobbishness, and to increase a sense of the sanity and worth of the ordinary daily activities, especially the activities of the teaching profession.

There are other approaches to this same end, of which our professors are availing themselves. Courses in ethics are being given in many of the American colleges with excellent effects, and in these courses particular pains are taken to study the relation of the college to the complex social conditions in which we live. The teacher of ethics has the advantage that he can treat with authority the question of moral standards, such as the relative claims of benevolence and justice, trained, hard-headed thinking on which is one of the present needs of the democracy. But from what particular department the advocacy of the social claim comes, is a matter of indifference so long as it comes with conviction and force. History, sociology, economics, ethics, pedagogy, English, other modern languages, Latin and Greek in a marked degree, as I have implied, offer the mature mind an opportunity of broadening the social sympathy and deepening the moral consciousness of the students. It is impossible, without going into the details of class work, to indicate fully the intimate, subjective value to character of the quiet presentation of social facts. We are enlisting the interest, the thought,

the sympathy and ultimately the activity of the students in the cause of social progress and public welfare. That the students recognize and cordially respond to the changing tone of college instruction many gratifying signs indicate. The excellent article in the number of *The Atlantic Monthly* for November, 1911, on "The College: an Undergraduate View" saves me from the need of bearing further testimony on this point. If I might state the educational problem of the college instructor as it here presents itself to my mind, I should say: How can the esthetic appreciations of adolescents be transformed into the ethical judgments of the manly and womanly mind?

Naturally, in a really educational process such as I am briefly outlining the personality and ideals of the instructor must play a large part, and the change in the social efficiency of the college toward which some of us are groping our way seems to imply a shifting in the conception of academic culture. It is difficult to arraign any type of culture, and almost ungrateful to imply that the eighteenth-century idea that the finest type was secured by reading a little good poetry, hearing some good music and speaking just a few words of sense daily is from our present point of view untenable. A comparison of two Oxford men of the nineteenth century, Lewis Carroll and T. H. Green, will help me in my statement. Lewis Carroll was a thoroughly cultured gentleman, presentable in the best society, a delightful companion, an ingenious writer, whose pages have delighted thousands in need of innocent entertainment. In addition he was for long years a college instructor and a contributor to the literature of mathematics. Green was a man of different stamp. He lacked something of the grace and charm of Lewis Carroll. He was less popularly known, but no less socially important. His contributions to the literature of philosophy were weighty. He was the leader of a great movement in the history of the thought of our race. He exerted an immense influence on the minds and conduct of the college men with whom he came in contact. Through Mrs. Humphry Ward's presentation of him as the Mr. Grey of "Robert Elsmere," he gained recognition with the reading public as one of the great forces in modern social progress. Lewis Carroll was extremely conservative, opposed to the rights of women, complacent about children's acting on the stage, hostile to the advance of science study at the university. Green succeeded in the conciliation of town and gown, became a member of the municipal council, was instrumental in establishing a local secondary school, and had his university duties permitted it, might have become representative of the city in the councils of the nation. He extended his sympathy to the cause of human liberty beyond the sea, and received the news of Gettysburg and Vicksburg with the enthusiasm becoming a large man. Can we not say that he represents a type of culture as worthy as any, and increasingly de-

sirable in the colleges of a democratic country and race? The changed conception of culture I have tried here to indicate as increasingly characteristic of the academic mind must impress college students with the reality, the robustness, of our ethical aims, and make of great educational value any instructor, no matter in what department, who holds and embodies it.

When young people leave college halls with dreams of the betterment of the human race, they should in the first place make sure that they do not prove a burden to their own families. An up-to-date, democratic culture should not interfere with their earning their own living. In fact, if properly educated, they will see in the choice of a calling a question of the greatest moral moment. To fit oneself for a vocation, to adapt oneself in a business way to society, is not hostile to true culture. It is in recognizing the real bearings of our daily task, and taking satisfaction in it that we grow into the only culture that seems worth while to the adult mind. Is it too much to say that one of the dangers of our age is the dilettante pursuit of scraps of the arts, and crumbs of the foreign languages? In the years of maturity the cultivation of these interests has something of the pathos of arrested development recurring to the styles and ideals of the teens.

The change in the attitude of professors and students towards the needs of the people and the welfare and progress of society, so intimately educational in its nature, seems to me the most promising factor in the movement for college and university reform. As a professor of pedagogy I would here lay the chief emphasis; but this change in the conception of academic culture implies further changes to which I must hasten.

Space does not permit me to speak of all that American colleges are doing, all that is still left them to do, in laying the cultural foundation, as I understand the term, for the learned and other professions. If our doctors were all true guardians of the public health, if all our engineers were bent on furthering hygienic conditions, if all lawyers were zealous in the cause of social justice, if all clergymen appreciated the larger aspects of the people's needs, the cause of human welfare would be secure. I must pause a moment, however, to say something concerning the relation of the college to the schools.

In the American college that I know most intimately about four hundred students are received annually from the secondary schools and other colleges. About one hundred and fifty are graduated every June. Of the graduates, seventy or seventy-five return as teachers to the schools. The secondary school affords the college, therefore, one of its most important points of social contact. It is largely through the high schools and academies, which in turn influence the grades, that the college makes its culture tell on the lives of the poor and common people,

from whom the majority of us are sprung. If we seek an aim, and are not blinded by academic pride, here is one right at hand. You will not be surprised to hear that the policy of the modern department of pedagogy is to help, not to exploit, the high school. The social point of view is capable, perhaps to a greater degree than one might at first expect, of modifying our procedure in dealing with the lower schools. The chief function of a college department of pedagogy is to turn out well-prepared teachers, enthusiastic, and with the right attitude toward their work. It should not, in my judgment, lend itself to cheap advertising, or drumming up students, or making a hit with the high schools and academies. Those imbued with the social spirit will find the hundred problems of adjustment of the college to the secondary schools too vital to be dealt with in a narrow or commercial spirit.

The relation of the college to the rich is no less important than the question just discussed, if the college is to preserve the right tone towards the social needs and aspirations of the whole people. The history of European universities shows that these institutions have been used to further the political views of their founders. In France and Germany, for example, universities have been used almost like fortresses to hold territory gained in war, as can be shown by reference to Breslau, Strasburg, Bonn, Bordeaux, Caen and Poitiers. The numerous universities organized by Napoleon were designed to carry out his policy of government. In view of this background afforded by history one can not be indifferent to the influence of founders and patrons upon their universities. Just how the millionaire founder or the millionaire trustee affects the social relations of the college calls for more extended statement than space here permits. In a few glaring instances in this country there have been serious infringements by the wealthy supporters of a university upon the spirt of academic freedom. But the predominance of the rich in the councils of the college has acted more insidiously in the social ideals that they perhaps unconsciously put upon the institution. One might mention briefly the expenditure of money from the business standpoint of the advertiser rather than from the educational standpoint of the professor; the treatment of the instructors as employees rather than as a body of self-respecting gentlemen working in a great social cause; and finally, the character of the officers likely to be chosen by trustees filled with a commercial rather than an academic spirit. A glance at the constitutions and administration of the universities in monarchical Europe as compared with these features of American universities causes no small wonder that in this country institutions of higher learning are comparatively aristocratic, not to say autocratic. The University of Oxford, for example, is governed by three bodies, council, congregation and convocation. The first, council, is made up of six heads of colleges, six leading professors, and six

representatives of the alumni. This is the cabinet of the academic state. The second, congregation, consists ideally of the teaching force of the university. It has important legislative powers. Convocation is made up of the M.A. alumni who have maintained close relations with their alma mater. This body chooses the chancellor of the university, exercises the right of veto, elects members of Parliament. Even this scheme is now undergoing reform along even more democratic lines. How far behind we are, with many of our colleges and universities governed by a secret conclave of wealthy men and a president not responsible to the teaching force or to the alumni!

To prepare citizens for a democracy the organization of the college itself must be democratic. If it be true that we learn to do by doing, the student should learn at college to be a citizen of a free state, not alone by precepts or academic instruction, but by the experience of membership in a free college community. Wherever there is an absence of social aim and organization on the part of college officers it is little wonder that the student body is lacking in purpose and does not rise above a community consciousness of a very primitive sort. With the colleges filled with the right social spirit the students feel themselves the members of a great republic of letters, or rather, of a democracy of science, possessed of a truth too vital to be merely individual and academic. The utilization of the ethical and social life of the school as a means of moral education, which, since Arnold's day, has been a recognized feature of the great English public schools, where, as Haldane remarks, English boys are permitted and encouraged to govern one another, is still almost unknown in some of the American colleges. If the president and the professors take the students into their confidence in the discussion of general aims as regards the welfare and progress of the people, then the corporate life of the school can be organized on a higher basis, discipline becomes more and more self-discipline, and anti-social types feel themselves condemned by the judgment of their peers in academic standing.

A measure of the change for want of which many American institutions of higher learning are suffering to-day was wrought out in the German universities by Fichte and others over one hundred years ago. It can be described briefly as a greater measure of freedom, spontaneity, self-activity. One should not, however, forget that increased freedom must mean an increased sense of responsibility and that self-activity must be activity of social import under social stimulation. When the members of the college understand their true social end and aim, athletics will occupy a more subsidiary place, and our institutions of higher learning will be more than mere clubs for wealthy young men. It is only in the absence of the enunciation of serious purposes that the college shows the tendency to triviality and puerility of which some

complain. The youngest freshman knows that success on the athletic field is not the chief end of man, and he is quick to note the falsetto in the football enthusiasm of the middle-aged and elderly professors when they pretend that the scores of the teams are the chief topic of academic interest.

Lack of appreciation of the educational value of college organization has blinded some educators to the merits of college fraternities. These organizations have a long and interesting history which can be traced back to the medieval nations at Bologna, Paris and the other early European universities. At present the college officer is likely to regard them rather as an administrative danger than as an educational opportunity. In our present system the fraternities are in effect if not in fact the vestigial remains of a university constitution in which the student body and the alumni played a vastly more important part than they do with us. A revival of academic freedom would restore the fraternities to their healthy functions. Now, as Birdseye and others too plainly show, a college fraternity, like other rudimentary organs, is liable under unfavorable conditions to deterioration and disease.

Again, if the students and the college in general with a fuller measure of academic freedom and an increased sense of their social responsibility would reconsider the curriculum and methods of instruction in the light of democratic principles, many wholesome changes could be brought about.

Besides instruction in sociology and the social aspects of pedagogy, economics, history, English and foreign literature already spoken of, I wish to mention here only one other subject, namely, physiology. Recent developments in natural science, above all, progress in bacteriology, have made the pursuit of this subject in college a pressing need. In addition to courses in scientific physiology we should have in every college popular courses on applied physiology for all the students, dealing with the vital questions of hygiene. Such courses are necessary for the guidance of the undergraduates in reference to diet, sleep, habits of study and of personal health in general. For, keeping our social purpose in view, it is not hard to see that one of the chief endeavors of the college should be to disseminate through the schools and in the homes the knowledge of hygienic science that is so necessary for the comfort and welfare of the people.

The social test of college culture would suggest many changes in the content and method of other college courses. The spirit of pedantry, to which all academic life is liable at times to fall victim, would be rectified by the challenge: "What is the social value and import of this?" If every college course were in its content socially important, then the students taking part would work more spontaneously, and the present methods of dictation and exact prescription would give way to greater

activity and initiative on the part of the student and greater freshness of response and cooperation in general.

The best methods, however, and the best results from college work can only be obtained when all college students and professors are engaged on some real, useful work instead of busying themselves with mere exercises. The tragedy of college life as seen by the up-to-date educator is that we in many cases are attempting to train for life activity by a series of exercises that can be regarded only as remote approximations to actual activities. This fault shows not merely in the college of liberal arts, but, where one would least expect it, in professional, and in spite of the rapid introduction of practical work, even in many engineering schools. In four or five years the engineering school as a rule does not undertake to teach engineering, but only to give preliminary exercise work to form in the future the basis for acquiring the profession of engineer. The remoteness of academic training from the real goal to be attained is naturally more marked in the other departments. One phase of this weakness is found in the endless theme work produced by students in compulsory English composition. As has been wittily said, there is a great difference between having something to say and having to say something, and in the work of composition the student is, indeed, placed in a notoriously artificial attitude. This serves here, however, merely as an illustration of a general defect observed in college work, which in the opinion of the writer results from our failure to demand for our work a social aim and purpose. How to provide real work and real activities for a thousand students on the college campus is a matter calling for some exercise of ingenuity. I must content myself with a single illustration of the work that might engage the scholarly activities of our undergraduates. The need of good translations of French, German, Italian, Spanish and other scientific works, our college and university men will readily join with me in recognizing. With, let us say, five hundred students in French, six hundred in German and a proportionate number in the other foreign languages, something of social value could surely be done in this matter under the direction of capable instructors. The translation last semester by eleven students in one of my classes of a complete French book of over three hundred pages opens up a vista of possibilities of real cooperative work of public importance.

If we held consistently to a distinct social purpose, most of the valid criticisms one hears of the college would be met. One of the severest critics of higher schooling of all sorts complains especially of the lack of effort at moral improvement. He emphasizes the futility of the college in helping the young man of limited means in the fundamental social matter of earning his own living. Others join him in pointing out the tendency of some of the colleges to become mere play-

grounds for the leisure classes. Many critics within and without the college comment on the lack of serious purpose among the students, the failure of the heads of colleges to formulate for their institutions a definite aim and program. Others concentrate their attention on administrative questions, the lack of responsibility of the trustees, the helplessness of the faculties, the autocracy of the president. Finally, it is admitted by an eminent educational authority that a fair equivalent of a college training can be gained through correspondence or even a brief course of reading. Such pessimistic comment falls away from a college or university animated by such social spirit as I have sought here to indicate and advocate. Such a spirit will entail not a narrow, but a broad curriculum to answer the needs of an increasingly complex civilization, and a more liberal discipline with more guidance, and less repression, more freedom and an increased sense of responsibility, in order to fit for citizenship in an enlightened and self-disciplined democracy. Great changes in administration are inevitable, an autocratic university is incompatible in a free democracy, but the essential change needed is an educational rather than an administrative one.

The typical American college has been necesarily denominational to maintain the doctrines and faith that to its constituency seemed vital. In the present great diversity of belief many of the colleges show little or no sectarian bias. Unless these institutions are, with increased liberalism, to be marked by laxity of principle, and flabbiness of moral purpose, they must gain a new motivation worthy of the times, they must work under the inspiration that a hope and faith in human progress gives. To show how the minds of students can be affected educationally so that the college may be touched with this spirit of modern democratic culture is the main purpose of these pages.

In conclusion we may say that the change we seek to further in harmony with an evolution already under way is designed to make the college responsive to the social need of the present, to render it more publicly significant, possibly less denominational, certainly not less religious. In a word, one might say, more democratic and less sectarian.

MODERN SCIENTIFIC THOUGHT AND ITS INFLUENCE ON PHILOSOPHY

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I

TO enter upon a discussion of the influence of modern scientific thought upon philosophy is to find one's self beset by temptations to a discursiveness not possible within the given conditions of time and space. Under such pressure, one might be led easily into a consideration of relative values—efficacy of methods, seriousness of limitations, ultimate soundness of criteria, the final significance of present tendencies. As I write, however, these problems seem so turgid with potential misunderstanding as to embarrass rather than facilitate the discussion that, as a student of biology, I had planned. To avoid such embarrassments, attention will be focused on the general theme through an examination into the nature of scientific truth. This procedure not only will put into my hands an instrument whose uses are relatively familiar to me, but will serve, I believe, to illuminate some of the most significant phases of modern philosophic thought.

Poincaré has somewhere made a suggestive comparison between the Gallic and Anglo-Saxon genius. Characteristic of the one is a feeling for form, for symmetry, for logical completeness, for finality; characteristic of the other is a feeling for substance, development, function, change. For the one, truth lies in the result; for the other, in the process. One is represented by a deductive, the other by an inductive type of mind.

I have no desire to raise here a national issue. Whatever the merit of this characterization of these ethnic groups, it will serve my purpose if it give vividness to the statement that the same general differences distinguish certain philosophers and scientific investigators. Wherever one finds a faith in final causes, a hope in the revelation of ultimate truth, there one finds a philosopher who, like the Frenchman of Poincaré, has drawn the essential elements of his inspiration from the philosophy characteristic of ancient Greece. Modern science may have supplied his convenience with the telephone and the electric light, the automobile and the thoroughbred, aniline dyes and serum therapy; but it has done little more. Until he views the truth as nothing final, as existing in

the process rather than in the result, as a growing, expanding, changing vision, blooming with youth as long as human life can use it, it can hardly be said that his eyes have felt the touch of the spirit of modern science.

Wherever modern science has affected characteristic changes in the trend of philosophic thought, the result has been achieved by lessening the influence of that ancient legacy which may be conveniently referred to as the doctrine of final causes.

It must not be inferred, however, that the influence of this doctrine has been confined to philosophy alone. It has been felt in every field of human inquiry that presents a speculative aspect, an opportunity to reach by means of the imagination into the unknown. The history of science is one long record of struggle between just those types of mind that Poincaré has sketched. In none of the sciences, however, has the conflict been more prolonged and bitter than in biology. There the fight has been waged about the four great problems of evolution, individual development, vitalism and adaptation. None more than these offer speculative opportunity—abundantly accepted. None more convincingly than these show the inexorable incompatibility of faith in final causes and scientific progress.

I present them, therefore, as my chief aids in developing, if I may, a fruitful conception of the nature of scientific truth. Having reached such a conception, we will proceed to discuss its relation to the philosophic thought of the day.

II

Faith in final causes is not a necessary product of a particular civilization, of civilization at all. Though it may persist in the midst of sophistication, it is born of inexperience. Under one form or another, it has existed among peoples of all sorts, wherever they have possessed sufficient intelligence to hazard an interpretation of their universe of experience. Of these peoples, the Greeks and Hebrews claim our especial attention, since it is from them that the main streams of our philosophy and science and religion flow.

Compared with the sophistication of Aristotle's theories of life, the cosmology of the Mosaic record is strikingly anthropomorphic and naïve. In spite of this naïveté, however, there is no question of its astounding control over the history of scientific thought; the more so, since it is to the second and far cruder story of the creation, in fact, in the second chapter of Genesis that the church chiefly pinned its faith in its long struggle with the doctrine of evolution. The struggle has been at times debased with bitterness and violence. One grows heart-sick at the sad spectacle of a Galileo swearing away his scientific probity as he groveled in fear of torture before the Inquisition.

But it has not been through such violence alone that the influence of the Hebrew tradition has been felt. More subtly did it discourage the great anatomist, Vesalius, who, in the flower of his young manhood, filled with the spirit of the pioneer, linked his fortunes to the throne of Charles and Philip. It is significant that, while he idly fretted out his life on Spanish soil, Suarez, the Spanish Jesuit, was born, destined to create the doctrine of special creation in its modern form by reaffirming in detail the Mosaic account of the creation—even the episode of the rib. The fact carries a suggestion of the reason why the productive years of that great progressive in biological science were limited to five, and ended with his thirtieth anniversary.

It was against this anachronistic doctrine of special creation, crystallized out of the civilization of the seventeenth century, that Darwin launched his great argument in the shape of the "Origin of Species." But, in doing so, he found in his opponents Hebrew tradition mixed with Greek. Evolution was not a conception hostile to the mind of Aristotle, though what we now recognize as phenomena of evolution did not especially engage his attention. The two rather ambiguous passages in which he arranges living creation in a series of closely intergrading types might be interpreted in terms of evolution without doing essential violence to his general conception of life. The origin of species of organic beings was not with him an issue. He was unaffected by the Mosaic record. Historical problems were to him of less moment than essential relations of structure and function. His especial interest in the ultimate analysis of truth was not, however, incompatible with an admission of the transformation of organic types. Indeed, under the influence of Aristotelian philosophy, St. Augustine himself sought to interpret the Mosaic cosmology with its conception of an external Creator, in naturalistic terms that should harmonize with the Greek conception of forces and potentialities inherent in the universe itself. It is this mixed derivation that complicates to some extent attempts to trace to their origins the ideas of the modern world.

There was no fundamental incompatibility then, between Greek tradition and the doctrine of descent with modification. As an evolutionist, Aristotle was at least as modern as Charles Bonnet. Were he alive to-day, I should confidently look for him in the foremost ranks of biological thinkers. His biological contributions, however, have been largely obscured by his versatility of interest in final causes. This interest I am disposed to believe was a product of his time, of the age into which he was born, of his education, his companionships, rather than a fundamental tendency of his mind. However it may be interpreted, there is no doubt that his ideas on transformism in organic nature were definitely limited thereby. If he was an evolutionist, he was also a teleologist. Adaptation in nature spelled for him design.

Organic types might change, but in accordance with a perfecting principle that should lead finally to the crowning glory of the evolutionary series, the human species. Perfecting principles are not unknown—witness Lamarck and Nägeli—in the speculative biology of the last century. In the hands of no one, however, have they proved to be instruments by means of which discoveries are made. Their influence has been conspicuously negative.

It was essentially Aristotle's teleology that Darwin, as late as 1859, overmastered with the doctrine of natural selection. It was Aristotle's evolutionary series, ending with man, that, fashioned into the semblance of a pine tree by Lamarck, was finally displaced by Darwin's conception of a genealogical tree without a central axial trunk flowering at the tip in man, but branching polychotomously in all directions from a common center. This modern conception harmonizes with the fact that there is no evidence that man has been fashioned, whether by special act of an external creator as in the old Hebrew account, or by the less direct process of evolution under the guidance of a final principle inherent in nature, as in the Aristotelian tradition, to be the lord and highest product of organic creation.

The Hebrew tradition embodies too naïve a conception of final causes for the philosophic as for the scientific minds of to-day, although it still lingers in various forms of religious doctrines that typically compose themselves, as President Jordan has somewhere aptly remarked, out of the débris of our grandfathers' science. Aristotelian evolution still lingers, though negative and barren on the fertile soil of modern experience, in the minds of those who admit with Aristotle the evolution of the physical man, but view, with him, the mind as a thing apart. It is characteristic of a faith in final causes that it permits distinctions of this sort. To the average biologist, however, to admit the validity of the distinction would be to question the validity of organic evolution itself. For the evolution of the body is neither more nor less certain than the evolution of consciousness. Both, for the student of objective science, rest upon evidence of the same order.

It was to be expected that Aristotle, a pioneer in science, would overestimate the simplicity of his problem of creating order where order had not reigned before, that he would seek for final causes with a suggestion of the simple confidence of the woodsman who traces smoke to fire or hunts his quarry to its lair. He was, scientifically, of necessity unsophisticated.

It is on other grounds that we must seek an interpretation of the persistence of this phase of his influence in contemporary thought; a phase which I suspect he would now agree was the portion of his legacy least worthy of our regard. There is something foreign to the spirit of Aristotle, something savoring of a sophistication born of conflict he

could not have known, in the following passionate challenge of a modern defender of the faith in final causes:

"Let not science contrive its own destruction by venturing to lay profane hands, vain for explanation, on that sacred human nature which is its very spring and authorizing source." Modern developments in philosophy itself indicate that the challenger need have no fear. Whatever the inevitable expansion of human knowledge may accomplish for human nature will not be by means of violent or profane hands. Conceptions of human nature, like all other conceptions of the human mind, adapt themselves quietly, impersonally, without anguish, to successive discoveries of truth.

III

Passing now to the problem of development, one is struck by the modern aspect of Aristotle's contribution.

Have you ever seen an egg grow? Have you perhaps followed the frog's egg, as it splits up into a group of segments; seen a cleavage furrow spread across it, new furrows succeeding each other with every half hour; observed the segments rhythmically swell and flatten with each cleavage; felt the mystery of this marvelous plastic process of development? Here is life; here is activity. And the juxtaposition of these phrases is not accidental.

Aristotle knew nothing of the cleavage of the frog's egg. He had no knowledge of the segments thus formed—which are now called cells. He did not know that the egg, is a cell also, comparable with the cells that make up, as fundamental structural units, the various organs and tissues of the body; that the egg like these other cells, possesses a characteristic body called the nucleus, which, as in all nuclei, contains a substance (chromatin) now generally understood to be most intimately concerned with the phenomena of differentiation and heredity. He was ignorant, also, of the nature of the male sex element, vastly smaller than the egg and differing from it remarkably in form, being adapted to a life of great activity. Otherwise, he would have known that the sperm, like the egg, is, in spite of its size and form, a cell, furnished with a nucleus and chromatic substance. And had he lived as late as 1875, he might have known that the essential facts of fertilization consist not only in the stimulation, the activation of the egg by the single sperm which penetrates its substance, but in the fusion of the egg and sperm nuclei and the mixture of the chromatin thus derived from the two sexes.

Nothing of this Aristotle knew. But he had observed the development of the chick. Without the microscope he had failed to note the early stages one sees so readily in the frog. But he had seen the embryo gradually appear on the upper side of the inert yolk, and he had seen

the heart begin to beat on the third day of incubation. It all impressed him to an extent that led to a treatise on generation.

To account for what he saw, he conceived the egg—the female contribution—to be essentially passive, containing elements that could be wakened into life by the active principle of the male. This he conceived to be a sort of enzyme, a ferment, which acted upon the female germinal substance like rennet upon milk. From this simple beginning he believed the development to progress, organ following organ; and since the spermatic fluid, the active principle, was itself unorganized, he rejected the possibility that parts should preexist.

Crude as all this is, it was an approximation to the truth, based on the facts as Aristotle had observed them. To this extent, his theory of development has a modern look. On a second glance, however, one discovers signs of the same eagerness for final explanations that we have already observed in our discussion of the problem of evolution. How, from so simple a beginning, was the remarkable complexity of the adult structure to be differentiated? And how was the fact to be explained that chick eggs, when they develop, always produce chicks, turtle eggs turtles; that animals reproduce after their kind? These were problems that at once engaged his attention, and were answered with characteristic promptness and confidence. Though the germ may be substantially simple, it is subject to two transcendental potentialities that constrain its development with reference to *species* and *form*.

And here Aristotle lapses out of the company of objective scientists. To say that an egg reaches a certain form because it possesses the potentiality to reach that form, is like defining a word in terms of itself. It is hardly the type of interpretation to commend itself to modern investigators. Yet it has been the refuge of many minds throughout the ages, and in a more refined and subtle form is used to-day by the distinguished author of "The Science and Philosophy of the Organism," to mask the hopelessness in his retreat from the firing line of experimental biology.

It is the ugly function of final explanations, causes, elements, principles, in biology, to call a halt. Trust them and, like the genii of old, they whisk one swiftly out of the current of scientific thought. One ceases to ask questions that are amenable to objective tests. And science itself stagnates until such questions germinate again in the minds of men.

From Aristotle to Caspar Friedrich Wolff extend two thousand years barren of inspiration. Harvey, the famous author of the "Exercitation on the Motion of the Heart and Blood in Animals"; Malpighi, his great Italian contemporary; and the indefatigable Dutchman, Swammerdam, had each made serviceable observations on the development of mammals, birds and insects, but had contributed no new ideas. By the

middle of the eighteenth century, there had still been no advance upon Aristotle, but there had developed a sharp contrast between two theories of development. On the one hand, Wolff supported the Aristotelian theory—now dubbed, since Harvey, epigenesis. On the other, Charles Bonnet, Albrecht von Haller and others elaborated its direct opposite in their theory of preformation.

Again, in Wolff's restatement of it, epigenesis takes on a modern aspect. The parts follow each other in development, and each part is primarily an effect of another preceding part and thereupon becomes the cause of another part that succeeds it. This is essentially the modern doctrine that one stage of development is conditioned by the stage preceding it as it conditions the stage that follows. It is crowded with suggestions; that bear no fruit, however, for lack of knowledge, in Wolff's imagination. Just as Aristotle endowed the simple germ with controlling potentialities that had no objective existence, Wolff achieved the same differentiation of the homogeneous germ by means of a *vis essentialis,* that sent him sailing also through the airy altitudes of final causation.

Contrary to the belief of Wolff, Bonnet and Haller found it impossible, on philosophical grounds, to conceive the beginning of the parts of an individual. For them, the germ contained the whole preformed in every part. While Bonnet insisted that man's body was not made like a watch, of added parts, but existed from the beginning as a whole, Haller was emphasizing the absurdity of believing that such a complicated apparatus as the eye could be formed as the epigenesis of the day demanded, out of crude materials by mechanical forces. Malebranche brought forward the clever device of infinite divisibility to overcome the patent objection that ordinarily the parts, whether present or not in the germ, could not at first be seen. And Bonnet admitted the obvious qualification that the parts need not exist in just the same form in the germ as they possessed in the adult. For him they belonged in the germ to a sort of invisible meshwork.

To this theory of development which sought to substitute for Aristotelian entelechies and Wolffian essential forces the conception that differentiation merely consisted in the expansion, with a push here and a pull there, of a structurally preexisting whole, numerous objections arose both in logic and in objective fact. If an individual were preformed in the germ, all the offspring of that individual must be preformed in it also. Which meant that, encased in the body of Mother Eve, one within the other, were all the germs of all the individuals of possible future generations—a sufficiently grotesque result. Wolff himself contributed one of the most telling facts against it when he described the formation of the tubular gut of the chick by the folding

up of a flat layer of tissue on the yolk. Obviously in this case the gut did not exist as such in the germ.

It is unnecessary to multiply objections to this interesting bit of metaphysic. Both the epigenetic and the preformationist theories of the eighteenth century are dead and buried under the relentless logic of events. Essential forces and preformed miniatures, alike in their finality, were unable long to withhold the attention of naturalists from the more potent suggestions of a rapidly growing body of new observations.

With the discoveries that organisms are built up of morphologically equivalent protoplasmic units, or cells; that both egg and sperm are cells, also; that the nucleus, especially the chromatic substance, is the part of the cell chiefly if not wholly concerned with the inheritance of the individual and specific characters and their distribution in the developing organism; more than all, with the discovery of the essential nature of fertilization, new theories were devised to interpret the still puzzling problem of individual and specific differentiation. These, like their prototypes of the previous century, fall into two contrasting classes.

Both of these classes of theories recognize that individual differentiation can not be interpreted without regard to race development. The germ from which the individual springs has history behind it, is composed, indeed, of two fragments of two preexisting individuals, the parents, who, in turn, sprang similarly from a previous generation. It is at once apparent that all modern theories of development must reckon with these facts; which means that, however simple we may conceive a given germ to be, the probabilities are overwhelmingly opposed to the conception that it is homogeneous; and they are equally in favor of the conception that it possesses from the start, in view of its relation to a preexisting parent, some degree of differentiation.

In perfect accord with these requirements, modern epigenesis and modern preformation nevertheless exhibit characteristic differences. On the one hand, is the preformationist theory of determinants devised especially to explain the persistence, through many generations, of very trifling characters, such, for instance, as a small pit on a human ear, recognized as a family trait, or a spot on one surface of a butterfly's wing, or a lock of white hair on a particular area of an otherwise dark-haired head. Such characters appear to come and go without effecting in any way the other characters of the organism. This independent variability is interpreted on the assumption of fundamental living units in the chromatin of the germ nucleus that represent and determine all the various characters of every individual. The germ chromatin is accordingly conceived to contain the determinants of all the heritable characters; and these are further conceived to be so associated, that in the

course of development the determinants are parceled and reparceled by the repeated divisions of the nuclear chromatin, an element in the cleavage process that, we have seen, is so striking a phenomenon in development. Differentiation thus depends not upon the literal expansion of a preexisting whole, but upon the *distribution* of the preformed determinants in the germ that have been inherited from preexisting individuals. And this distribution takes place, by nuclear division, in such a way that the right determinant always finds itself ultimately in the right place, that is, in the same relative position that that sort of determinant occupied in the parent.

The germ, then, is not only the abiding place of an enormous and complex assemblage of determinants, but these determinants are living morphological units. Not only that. They struggle for existence, according to the conception, just as organisms do. The basis of this struggle lies in inequalities in the food distribution in the germ, whereby some determinants will obtain less nourishment and weaken correspondingly, while others will obtain more nourishment and correspondingly strengthen. As the determinants in the germ, so the organs, the characters which they determine, vary.

By means of this ingenious application of the theory of natural selection to the vital units of which living substance is composed, the determinant hypothesis obtains a theory of variation which at once distinguishes it from the preformation theory of Bonnet. It goes still farther. Even the biophors vary—those ultimate vital units of which the determinants are the first aggregates.

With this liberal provision for variation, the determinant hypothesis would appear to have approached very close to modern conceptions of epigenesis. Certain fundamental differences, however, still persist. Whatever the provision for variation in the germ, differentiation proceeds, according to the determinant hypothesis, by the segregation of determinants already present in the germ; and these determinants are *vital morphological units.* According to the most advanced epigenetic theory, differentiation proceeds from a relatively simple germinal organization, not by the segregation of hypothetical vital units, but by means of progressive changes of a physico-chemical nature.

Just here appears the characteristic of the determinant hypothesis most significant for us. While the great inventor of the determinants finds it fundamentally necessary to assume a structure for living substance that is based upon ultimate vital units that have individuality, grow and reproduce, various investigators are discovering no such necessity in the facts. What *is* necessary is a hypothesis that will work. One of the strongest objections to the determinant hypothesis is, that, paradoxically enough, the chief researches it has stimulated are those which have been guided by the assumption that it would *not* work.

One need not fail to appreciate its logical completeness, its symmetry, and the skill with which it has been defended, and yet one need not be blind to the fact that it has not been a stimulating guide for its friends. It has been conservative rather than progressive. Founded on a definite morphological conception of the ultimate constitution of living substance, it has not adapted itself plastically to the rapidly changing conditions in biological science. The considerable amendment it has received in the last eighteen years has only made it so cumbersome and complex that it is now little more than a mere formulation of the facts it attempts to explain.

Time will not permit us to explore thoroughly the mass of evidence on which this criticism has been based. While differentiation according to the determinant hypothesis assumes qualitative divisions of the chromatin in the nucleus, numerous investigations have shown that at least five divisions of the egg in some animals may occur before there is any recognizable difference between the cells thus formed. Each of the first sixteen is competent to develop the entire adult structure. The only way to account for such a result in terms of morphological determinants is to assume that a complete outfit passes to each cell with each division of the nucleus, obviously a serious burden for the determinant hypothesis to bear. Further, among these phenomena of development which are conveniently investigated under the head of regeneration, similar difficulties have so constantly recurred, requiring similar assumptions of reserve determinants, that the theory has long since ceased to interest investigators in this field. It follows, rather than leads, investigation. Finally, in the field of heredity, just that characteristic of Mendelian inheritance—namely, the segregation of parental characters in second generation hybrids—which at first seemed to give the strongest support to the conception of a germ plasm composed of morphological determinants, has now been resolved far more satisfactorily, because more simply and workably, in terms of chemical substances.

These cases lay emphasis upon the distinction between morphological and physiological conceptions that defines the essential difference between modern preformation and modern epigenesis. Instead of a congeries of morphological determinants, the epigenesist finds in the germ a problem in physical and chemical relations. He is interested in the dynamic aspects of development, in the energy transformations. He does not seek to construct a scheme of the ultimate organization of living substance, but he *does* seek to control its operations, to predict its behavior.

In this new form, the problem of differentiation presents many interesting aspects and is being encouragingly developed. By way of illustration, recent investigations indicate that color differentiation is based essentially on a well-known chemical process, the oxidation,

namely, of a chromogen or color base in the presence of an oxidizing enzyme or oxidase. Tyrosin, for instance, a colorless chemical compound and a product of the decomposition of tissue proteids, can be oxidized, in the presence of the enzyme tyrosinase, through a series of colors: pink, red, deep brown to black, the color depending, other things equal, on the concentration of the enzyme and the duration of its activity. Tyrosinase has been isolated from many organisms, and has been definitely connected with pigment formation in many cases. We are dealing here with known substances, not hypothetical vital units; with chemical processes that can be followed in the laboratory test tube. That an organism may develop a color characteristic of its parents, in the light of these facts which are representative of a considerable number, it is only necessary that in the course of its development tyrosinase be formed under conditions that make a reaction with the tyrosin in the tissues possible. Local production of tyrosinase would lead to local coloration, to spotting or characteristic marking. The amount of tyrosinase—that is, its concentration—in connection with local conditions that might favor or inhibit the reaction in varying degrees, would determine the characteristic shade of color.

It is impossible in the brief time at my disposal to consider the various complications of this type of problem. The difficulties are very great in the way of investigations which as yet have hardly begun. Enough may have been said, however, to indicate the direction of some of the most recent and most promising work. If color characters are dependent upon chemical reactions, other characters probably are also. In fact, recent work upon the old problem of the heritability of acquired characters has brought to light interesting chemical possibilities in inheritance, and lifted the incubus of presumption laid by Weismann upon the whole subject in the shape of the determinant hypothesis almost twenty years ago.

Modern epigenesis recognizes an organized germ, more or less differentiated, but vastly simple in comparison with the preformed germ. That color may be produced at a given stage in the development of an organism, it is not necessary that the tyrosinase, upon which the formation of the color may depend, should be present as such in the fertilized ovum. It is only necessary that the conditions for its ultimate production be present—relatively simple conditions, that bring about a series of reactions of the type known in physiological chemistry as autocatalyses, in which one phase in the reaction determines the succeeding phase. Not only is this sort of conception more simple than the determinant hypothesis, but it is stimulating. It is workable. It leads to results that are sympathetic with the most advanced scientific work of the day. It is not a final explanation. It is an implement of research.

IV

The problem of vitalism need be very briefly examined. Vitalism, if it means anything in biology, interprets life in terms of forces or agencies or processes that are not found in inorganic nature. According to this definition, Aristotle was a vitalist when he conceived the development of the germ to be guided by the entelechies that determined specific and individual form in organisms. Wolff was a vitalist when he accounted for the differentiation of a homogeneous germ by the aid of a *vis essentialis*. Vital forces have long since lost their grip. They began to weaken when Wöhler, in 1828, produced in the laboratory the compound urea, till then supposed to be formed only in the bodies of organisms. They broke into full retreat under the fire of calorimetric researches of the last century which demonstrated that oxidation was oxidation, whether it took place within or without the body, and that vital heat was as surely due to chemical reaction as the heat generated by the reaction between sulphuric acid and zinc.

So Wolff's vitalism is dead. The Aristotelian vitalism, however, has a representative at the present day in the neo-vitalism of Driesch. The Aristotelian entelechy has been revamped and applied to the unexplained residuum that has escaped Driesch's experimental analysis. It is interesting that Driesch was a metaphysician first, an experimental biologist second; and that after about fifteen years of unusual activity in this second rôle, he returned to his first love. In these fifteen years he developed what he has called three proofs of vitalism. But he has not succeeded in persuading many biologists to accept his criteria of demonstration. It is difficult to take seriously his conception of entelechy, a non-substantial, non-energetic principle which yet is competent to control the developmental energies of the organism. It is but another final cause, an ultimate term in the analysis of the activities of organisms. And it has weakened Driesch's interest in biological research just as the formulation of final explanations has led to stagnation wherever we have met them along the line of biological inquiry.

In contrast with Driesch, there is a large and eager group of experimental biologists who unite in deprecating his interest in entelechies and, undaunted by its enormous complexity, in investigating the organic mechanism in the hope of reducing more of it than he was able, to terms of physics and chemistry. How far they may go is not, from the standpoint of modern biology, a pertinent question. How they may keep moving is more to the point. To this end the Drieschian entelechy offers not the slightest suggestion of encouragement.

V

Three of the four problems to which attention was invited at the beginning of this paper have now been considered. If I have succeeded

in presenting intelligibly the actual development of modern ideas, it has been shown that science has progressed, with respect to these problems, by abandoning a faith in final causes for a faith in the hypothesis that works, by draining off every stagnant suspicion of ultimateness in explanation, in the light of the conviction—the product of experience—that the ideas that serve us change with our knowledge of objective fact. I shall now attempt to show that this statement applies with equal force to the development of modern conceptions of adaptation in nature.

The problem of adaptation possesses a peculiar fascination for the imaginations of men. It inheres in every mechanism that meets a human end. Watches, beehives, steamships, reciprocating engines, footballs, blackboards, fountain pens and yellow paper—all are obviously fashioned toward ends. Why not that all-inclusive mechanism, the universe itself, and all that in it is?

When Darwin came upon the field in 1859, the widespread opposition which evolution theories had already experienced lay intrenched behind an affirmative answer to this question. These were the works, first of all, that Darwin stormed with his "Origin of Species." The struggle did not center about the problem of species, though one may well gather a contrary impression from the familiar abbreviation of the title of that epoch-making book. It is in the sub-title—"the preservation of favored races in the struggle for life"—that one discovers his real objective—a mechanical theory of adaptation in organic nature. It was just because the supporters of organic evolution had lacked such a theory that they had failed to impress, not only the thinking public, but most of their biological brethren. Darwin was not reviled as an atheist because he believed in evolution; nor for that reason did he revolutionize the whole course of modern thought. It was because his doctrine of natural selection menaced the traditional Hebraic conception of the creation that he was anathematized by the standpatters of his generation. It was because he raised such a powerful presumption against all doctrines of design in organic nature that he was able effectively to substitute for doctrines of fixity and finality the fruitful conception of change. He did destroy the doctrine of fixity of species. He did establish the doctrine of evolution in its place. But he did so by eliminating teleological theories from the list of useful hypotheses in science.

The solution of the problem of adaptation is being sought with diminishing faith in teleological formularies. These are going the way of the other final explanations that have failed to fulfill in modern science the one prime requisite—active leadership. Since Darwin's time the attention of biologists has been shifting from those secondary adaptations which provide the material for natural selection, to the direct or primary adaptive responses of the organism to given condi-

tions. The phenomena of immunity, especially to bacterial poisons that are so conspicuous in modern medicine, are adaptations of this type. It is still too early to state with any certainty the exact nature of the processes involved in such cases. That they are physico-chemical processes of great complexity seems to be clear. In this respect they ally themselves with the well-known equilibrium reactions in chemistry, and the form changes that certain crystals undergo in response to changes in temperature. Here, in the inorganic world, are relatively simple analogues, at least, of the physiological processes that are associated with adaptation in organisms. It is significant of the present attitude toward problems of adaptation, that suggestions for their solution are being thus eagerly sought among the facts of physics and chemistry.

VI

Scientific truth, then, is not concerned with final solutions. Nothing perhaps has been more conspicuously characteristic of it, in this discussion, than its incompleteness, than its plasticity, than its capacity for indefinite expansion, than its stimulating power. To my mind, this last is its crowning glory. We dwell in a world of hypotheses, and we estimate them according as they are more or less workable. To those hypotheses that approximate most closely to the demands of wide ranges of fact, we give the name of laws. It is obvious, however, that such laws have varying degrees of certainty. Scientific truth is never absolutely certain, but there are always ways of determining what it may do.

For one who seeks a basis of criticism for a contribution to science, three obvious tests may be applied. (1) It may contribute new facts; (2) it may contribute a formulation of old facts; (3) it may contribute a new idea that, in the presence of facts, may lead to a new point of departure for explorations into the unknown.

If one were to apply these tests to what seem to me to be the two most significant developments in the philosophic thought of to-day, they might be said to fall, very roughly speaking, under the second and third categories. In the former might be placed the synthetic philosophy of Spencer, an avowedly scientific philosophy, whose essential problem was to formulate the known facts of science in term of principles of evolution. This stupendous project, remarkable alike for the powers of its author and the wide range of his interests, ended in a system of philosophy, into which just enough metaphysics succeeded in creeping to justify the criticism that, in spite of all good intentions, he had not been able completely to disentangle himself from the habits of thought to which his critics were happily accustomed.

In the third category may be placed that interesting application of

the scientific method to problems of conduct which is known as pragmatism.

Pragmatism distinguishes itself at once from the synthetic philosophy in that it is non-systematic. Instead of an interest in a formulated body of knowledge it appears to possess an insatiable desire to determine practical choices. Given a problem of conduct, the solution unknown; what shall be the line of action? Here one perceives a strictly scientific situation that emphasizes the practical value of the hypothesis. The problem is to find a satisfactory path into a new region. And the answer that pragmatism gives is, trust to luck and your past experience. The truth, says James, is the hypothesis that will work. The truth, says Dewey, if I rightly apprehend him, is the hypothesis that you can work with. There is a suggestion of permanency, of stability, of future significance in the latter phrase that makes it, to my mind, more felicitous. But I do not care to dwell upon that point. What comes closer to my purpose is to point out that here is no faith in final causes, here is no suspicion even of that innocuous phantom, the unknowable. Here is no distinction between science and philosophy—if indeed pragmatists *are* philosophers, in spite of the fact that, in one form or other, they fill several of the chairs of philosophy now in our universities. Here is a faith that facts will tell their tale—will inevitably condition the movement of ideas, that one's imagination content is derivable from one's effective experience. Here is a philosophy that is working a transformation on the thought of the day. How? By abandoning the search for lofty peaks of final causation, from which to triangulate the universe according to logical necessity; by emphasizing ideas that shall not only square with the facts as we find them, but shall create others.

Such I conceive to be the most significant effects of modern scientific thought upon philosophy. They are characteristic tendencies of the present day. How one may evaluate them, however, is a problem which, for the purposes of this discussion, I have already promised to avoid.

THE MAIN BUILDING OF ADELBERT COLLEGE OF WESTERN RESERVE UNIVERSITY AND THE MAIN BUILDING OF CASE SCHOOL OF APPLIED SCIENCE.

THE PROGRESS OF SCIENCE

THE CLEVELAND MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE sixty-fourth meeting of the American Association for the Advancement of Science, and the eleventh of the "convocation week" meetings, will be held in Cleveland from December 30 to January 4. Between twenty-five and thirty national scientific societies meet during the same week in affiliation with the association. These include the American Society of Naturalists and the societies devoted to anatomy, anthropology, astronomy, biological chemistry, botany, entomology, horticulture, mathematics, physics, physiology, psychology and zoology. There will consequently be a large gathering of scientific men at Cleveland and the tradition of convocation week will be worthily maintained.

The geologists meet at New Haven and the bacteriologists in New York, and the chemists have decided to meet hereafter in the spring and autumn instead of in the summer and winter. This change has been made by the chemists owing to the fact that those engaged in industrial work find the end of the year an inconvenient period and

INTERIOR OF THE AMASA STONE MEMORIAL CHAPEL OF WESTERN RESERVE UNIVERSITY.

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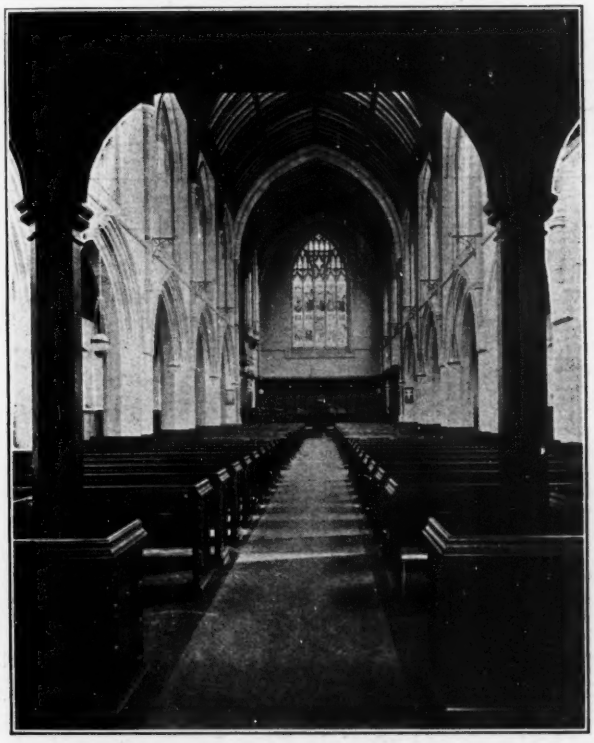
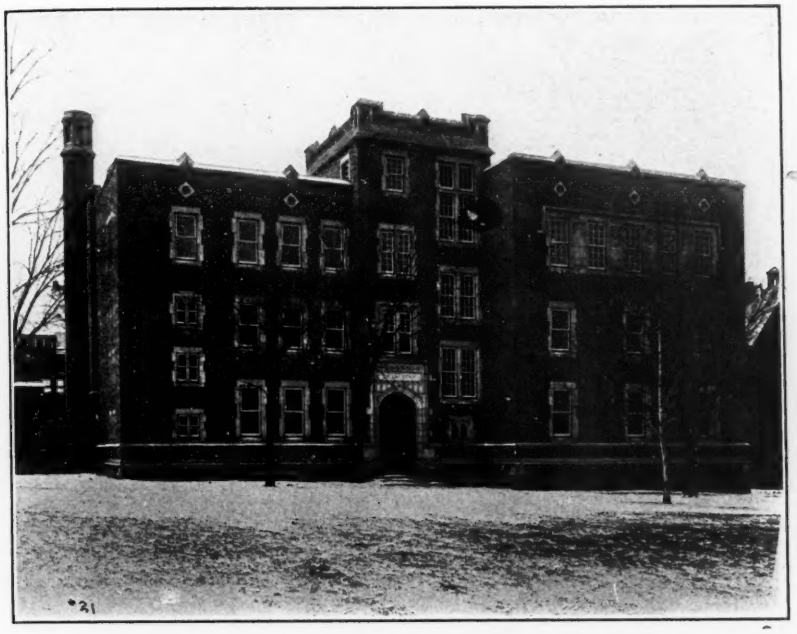


INTERIOR OF THE AMASA STONE MEMORIAL CHAPEL OF WESTERN RESERVE UNIVERSITY.

are besides not concerned with academic holidays. Similar conditions have led the engineers to meet apart from the American Association, and the societies devoted to economics, history, philology and other sciences which have been called "unnatural" and "inexact" meet separately. The convocation week meetings have consequently never fully represented the whole weight of science in America, and it is probably undesirable that they should attempt to do so every year. Such a gathering can only be held in one of the great cities, and there are advantages in small meetings as well as in a large congress. It would, however, be an admirable plan if once in five years all organizations concerned with research, higher education and the applications of knowledge could come together in order to demonstrate to themselves and to the world the great part that science plays in modern civilization.

Cleveland is perhaps the most central city in the United States for a scientific meeting. It is north and east of the center of population, but very close to the center of scientific population. A radius of 500 miles may include nine tenths of the scientific men of the country. The city has good hotel accommodations and, what is even more important, institutions which offer excellent places for the sessions and themselves add an attraction to the meeting. The adjacent main buildings of the Western Reserve University and the Case School of Applied Science are shown in the accompanying illustration. Western Reserve College opened in Hudson in 1827 and removed to Cleveland in 1882. As Western Reserve University since 1804, it has enjoyed a prosperous history, to the original Adelbert College there having been added a college for women and a graduate school, and in addition to professional schools of medicine and law, there are a dental school, a school of pharmacy and a library school. The medical school is one of the strongest in the country, having ten years ago adopted the requirement of three years of college work for entrance and having an endowment of one and a half million dollars, two thirds of which has been recently obtained. What is of even more consequence, it has on its faculty men of high distinction both in the scientific and clinical departments.

The Case School of Applied Science in like manner takes a leading position among our technical schools. It enjoys an educational affiliation with Western Reserve University by which students may complete their course by taking the first three years at the university and the last two years at the technical school. It will be a pleasure to physicists and chemists to meet in the laboratory named in honor of Professor Edward W. Morley, for many years professor in the university, a past president of the American Association and one of the most active of its supporters. There are other personal associations with the meeting in the fact that the vice-president of the section of mechanical science and engineering, Dr. Charles S. Howe, is president of the Case School, and Professor George T. Ladd, vice-president for the section of anthropology and psychology, is a graduate of Western Reserve University and has been a lecturer there. The other vice-presidents of the association and the presidents of the affiliated societies will give addresses of general interest, and there will be a number of discussions and general meetings that will bring together men of science working in different departments and should be attractive to those who are not professionally engaged in scientific work. The president of the association, Professor Charles E. Bessey, of the University of Nebraska, has chosen as the subject of his address "Some of the Next Steps in Botanical Science." At the opening session he will introduce the president of the meeting, Dr. Edward C. Pickering, director of Harvard College Observatory.

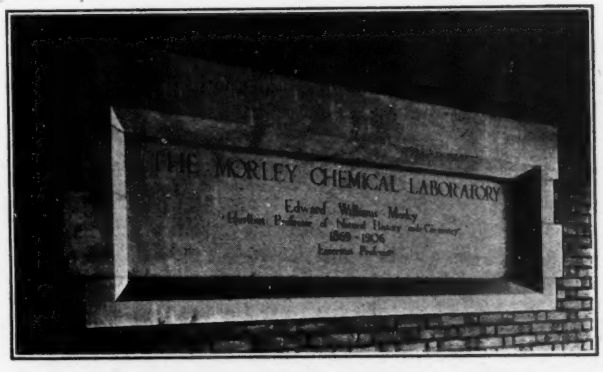


THE MORLEY LABORATORY OF WESTERN RESERVE UNIVERSITY.

THE SPREAD OF INFANTILE PARALYSIS

IN an article by Mr. Charles T. Brues, of the Bussey Institution of Harvard University, on insects as agents in the spread of disease, published in the last issue of the MONTHLY, a footnote was added to the effect that since the article had been written experiments with monkeys by the author and Dr. Rosenau showed that infantile paralysis, poliomyelitis, can be transmitted from one monkey to another by the stable fly, *Stomoxys calcitrans*. A brief account of the experiments was presented before the International Congress on Hygiene and Demography in September and has been printed in the *Monthly Bulletin* of the Massachusetts State Board of Health.

Monkeys were infected by injecting virus from man into the central nervous system, and large numbers of stable flies were permitted to bite them.



TABLET IN THE MORLEY LABORATORY.

Twelve healthy monkeys were then exposed to the bites of the same flies. Six of them contracted the disease and of these three died from it. The authors state that they would like to emphasize the fact that this does not appear to be simply a mechanical transference, but rather a biological one, requiring a period of extrinsic incubation in the intermediate host. Details are, however, lacking concerning the period of incubation and the precautions used to avoid passive contamination. Dr. Flexner had in one case obtained infection by a filtrate from bedbugs which had fed on the blood of inoculated monkeys.

The preponderance of infantile paralysis in August, September and October, its prevalence in rural districts and its failure to spread in schools, asylums and the like, suggest an insect carrier, and the fact that the virus is a filterable parasite, invisible with the microscope, suggests an analogy with yellow fever and dengue known to be inoculated by mosquitoes. Dr. Flexner and his fellow workers at the Rockefeller Institute have, however, adduced strong experimental evidence that the mucous membrane of the nose is the site both of egress and ingress of the virus. While the problem in the case of infantile paralysis is not yet completely solved we may take satisfaction in the progress made by experimental methods in discovering the causes and preventing the occurrence of many of the most terrible diseases.

SCIENTIFIC ITEMS

WE record with regret the death of Sir George Howard Darwin, Plumian professor of astronomy and experimental philosophy at Cambridge University; of Dr. Elie de Cyon, formerly professor at the Academy of Sciences of St. Petersburg and the author of important contributions to physiology; of Dr. Oliver Clinton Wendell, assistant professor of astronomy in Harvard University; of Eben Jenks Loomis, for a half century in the Nautical Almanac Office; and of Edwin Smith, connected with the U. S. Coast and Geodetic Survey since 1870, known especially for his work on determinations of the force of gravity.

THE Royal Society has awarded its medals as follows: a Royal medal to Professor William Mitchinson Hicks, F.R.S., for his researches in mathematical physics and investigations on the theory of spectroscopy; a Royal medal to Professor Grafton Elliot Smith, F.R.S., for his researches on the comparative anatomy of the brain; the Copley medal to Professor Felix Klein, of Göttingen, For.Mem.R.S., for his researches in mathematics; the Rumford medal to Professor Heike Kamerlingh Onnes, of Leyden, for his researches at low temperatures; the Davy medal to Professor Otto Wallach, of Göttingen, for his researches on the chemistry of the essential oils and the cyclo-olefines; the Darwin medal to Dr. Francis Darwin, F.R.S., for his work in conjunction with Charles Darwin, and for his researches in vegetable physiology; the Hughes medal to Mr. William Duddell, F.R.S., for his investigations in technical electricity; the Buchanan medal to Colonel William C. Gorgas, of the United States Army, for his sanitary administration of the works of the Panama Canal.

BY the will of the late Morris Loeb, formerly professor of chemistry in New York University, large sums are left to scientific, educational and charitable institutions, mainly subject to the life interest of Mrs. Loeb. Harvard University will receive $500,000 for the advancement of physics and chemistry; $25,000 is given to the American Chemical Society for a museum and $2,500 to the National Academy of Sciences. Part of the residuary estate goes to the Smithsonian Institution and to the American Museum of Natural History.